D02 FIU Site Characterization
Supporting Data

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See Configuration Management System for approval history.

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	10/25/2010	NEON.FIU.000259.CRE	Initial Release
B	09/23/2011	ECO-00279	Update to new document number's/template throughout document.

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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 02. This document presents all the supporting data for FIU site characterization at D02.

1.2 Scope

FIU site characterization data and analysis results presented in this document are for the three D02 tower locations: Smithsonian Conservation Biology Institute (SCBI, Advanced site), Smithsonian Environmental Research Center Relocatable site (SERC, Relocatable 1), and Blandy Experimental Farm Relocatable site (BEF, 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.

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 SMITHSONIAN CONSERVATION BIOLOGY INSTITUTE (ADVANCED TOWER SITE)

3.1 Site description

NEON SCBI candidate advanced tower site is located within the property of Smithsonian Conservation Biology Institute (SCBI, 38.892885, -78.139506), see Figure 1.

The Smithsonian Conservation Biology Institute, which launched on January 25, 2010, serves as an umbrella for the Smithsonian's global effort to conserve species and train future generations of conservationists. The SCBI is headquartered in Front Royal, Virginia, at the facility previously known as the National Zoo's Conservation and Research Center. The SCBI facilitates and promotes research programs based at Front Royal, at the National Zoo in Washington, and at field-research and training sites around the world. Its efforts support one of the four main goals of the Smithsonian's new strategic plan, which advances "understanding and sustaining a biodiverse planet." Conservation biology is based on the premise that the conservation of biological diversity is important and benefits current and future human societies. National Zoo scientists (among the pioneers in the field of conservation biology) have long been leaders in the study, management, protection, and restoration of threatened species, ecological communities, habitats, and ecosystems. As the benefits of conserving biodiversity become more commonly understood, the SCBI will allow Smithsonian scientists to be recognized as leaders in developing ways to stem the loss of biodiversity and aid in the recovery of endangered species and habitats. SCBI conducts research to aid in the survival or recovery of species and their habitats, and to ensure the health and well-being of animals in captivity and in the wild (Information source: http://nationalzoo.si.edu/scbi/default.cfm).

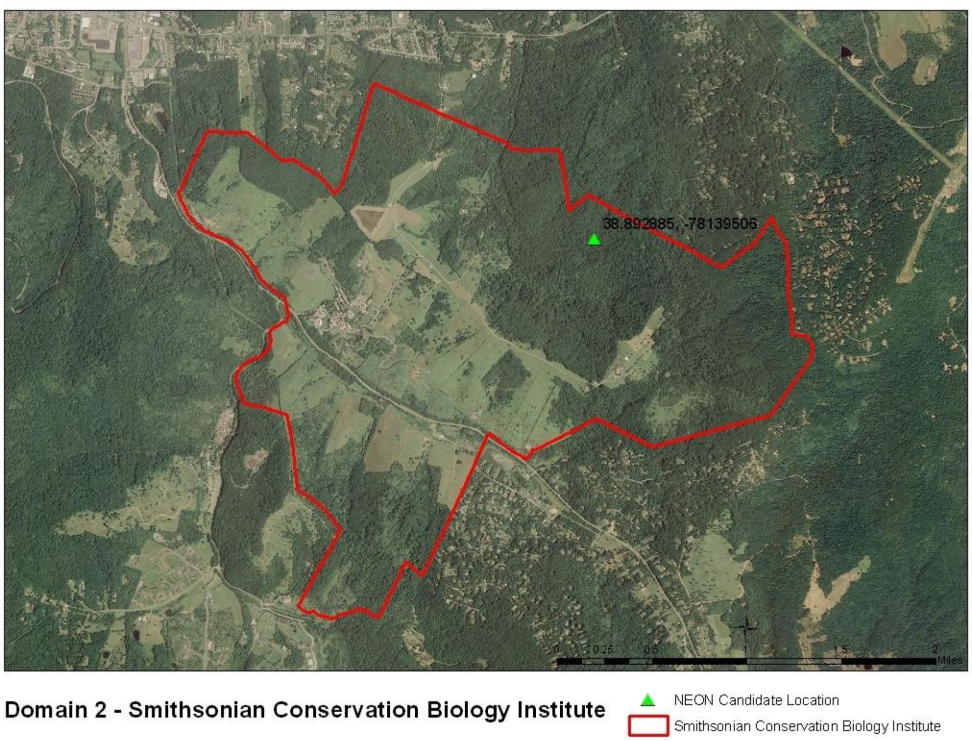


Figure 1 SCBI boundary map and NEON candidate tower location

3.2 Ecosystem

Vegetation and land cover information at SCBI are presented below:

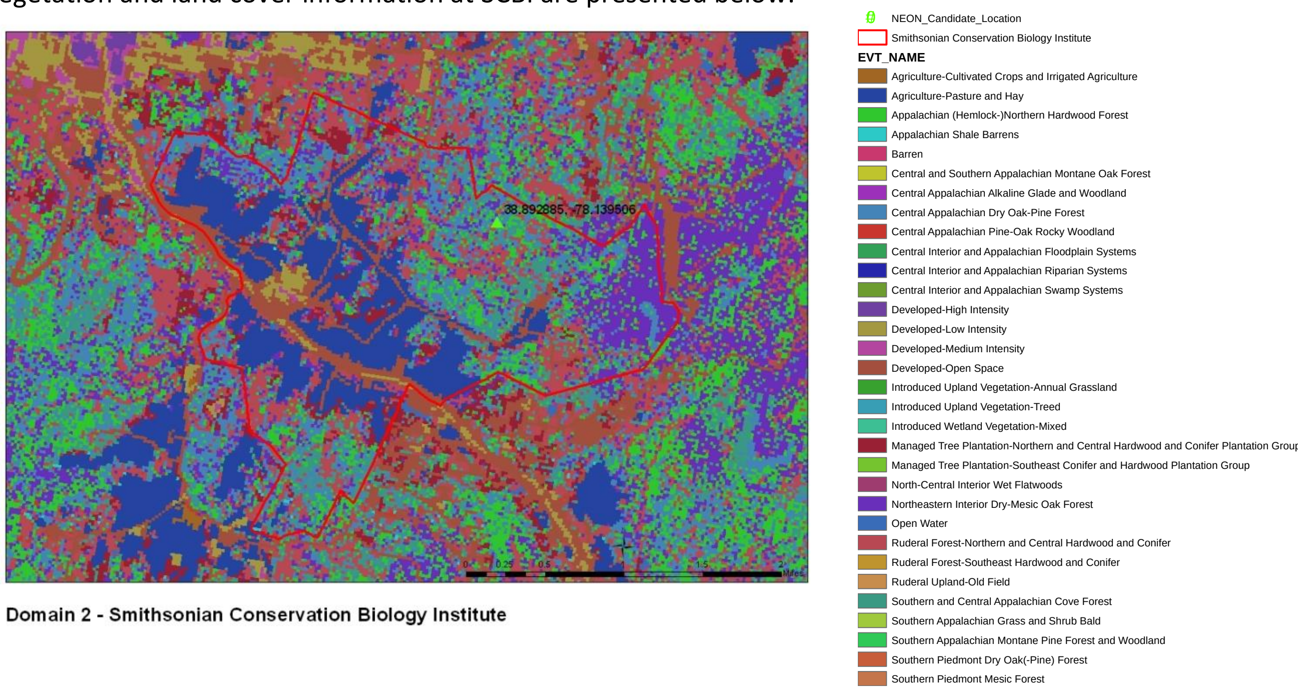


Figure 2. Vegetative cover map of SCBI and surrounding areas (information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm).

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

Vegetation Type	Area (km^2)	Percentage
Open Water	0.008845312	0.073747778
Developed-Open Space	0.896256678	7.472538488
Developed-Low Intensity	0.140262014	1.169434298
Developed-Medium Intensity	0.008235771	0.068665724
Agriculture-Pasture and Hay	2.782720836	23.20093011
Introduced Upland Vegetation-Treed	0.0036	0.030014994
Northeastern Interior Dry-Mesic Oak Forest	1.734173783	14.4586709
Southern and Central Appalachian Cove Forest	0.749280214	6.24712248
Appalachian Shale Barrens	0.012892541	0.107491539
Central Appalachian Dry Oak-Pine Forest	1.948285337	16.2438256
Appalachian (Hemlock-)Northern Hardwood Forest	1.17916539	9.831289386
Central Appalachian Pine-Oak Rocky Woodland	0.151241704	1.260977447
Central Appalachian Alkaline Glade and Woodland	0.00597635	0.049827805
Central Interior and Appalachian Swamp Systems	0.0009	0.007503748

Ruderal Forest-Northern and Central Hardwood and Conifer	1.925522812	16.05404309
Managed Tree Plantation-Northern and Central Hardwood and Conifer Plantation Group	0.446646764	3.723916619
Total Area Sq Km	11.99400551	100

The representative ecosystem that the NEON design is focused around for this core site is tulip popular and oak dominated closed forest, mixed with black walnut and ash.

Canopy height is ~35 m around tower site with lowest branches at ~7 m. Oak, ash and other tree species form upper understory with height ~ 8 m. Berry vines (species unknown) forms the middle understory with mean height ~ 1.2 m. New ash seedlings and grasses form the understory at ground level with height ~ 0.3 m. Plants of the top and middle understory are have the appearance of a random distribution. The vegetation of the story at ground level is very dense on the forest floor (Figure 3).

Figure 3 Ecosystem at SCBI Advance tower site

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

Ecosystem attributes	Measure and units
Mean canopy height	35 m
Surface roughness[a]	1.4 m
Zero place displacement height[a]	30 m
Structural elements	Closed canopy, understory present
Time zone	Eastern time
Magnetic declination	10° 3' W changing by 0° 1' W/year

Note, [a] From field observation.

3.3 Soils

3.3.1 Soil description

Soil data and soil maps (Figure 4 Table 3) below for the SCBI tower site were collected from 3.5 km^2 NRCS soil maps(http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm), which centered at the tower location, 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.

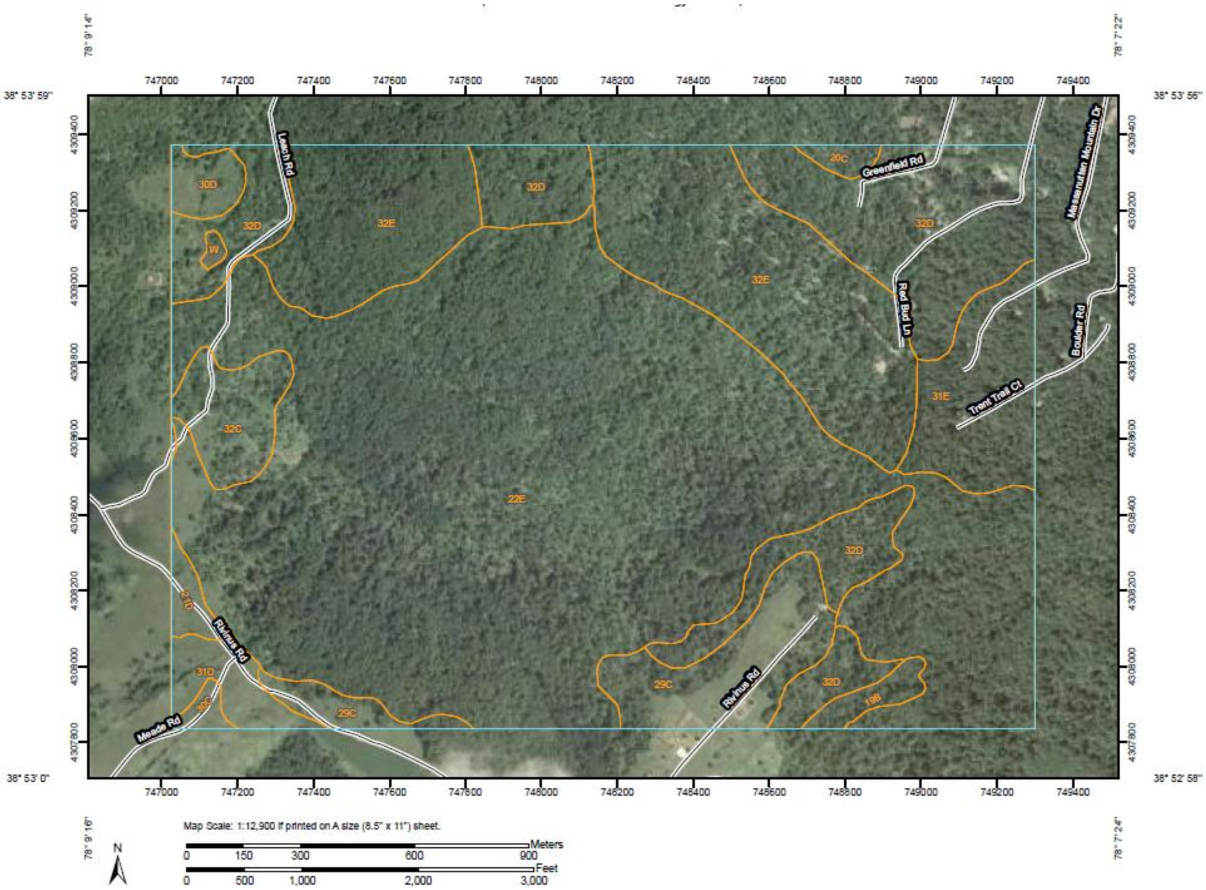


Figure 4. 3.5 km^2 soil map for the SCBI forest NEON advanced tower site.

Map Unit Description The map units delineated on the detailed soil maps in a soil survey represent 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, 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 soil types 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, is 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 3.5 km^2.
Area Object Interest (AOI) is the mapping unit from NRCS.

Warren County, Virginia (VA187)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
19B	Hawksbill cobbly loam, 2 to 7 percent slopes, occasionally flooded	5.8	0.7%
20C	Hawksbill very cobbly loam, 7 to 15 percent slope, occasionally flooded	3.2	0.4%
21D	Lew channery loam, 7 to 25 percent slopes	5.4	0.6%
22E	Lew loam, 25 to 65 percent slopes, very stony	466.7	54.2%
29C	Montalto loam, 7 to 15 percent slopes	42.8	5.0%
30C	Myersville silt loam, 7 to 15 percent slopes	2.9	0.3%
30D	Myersville silt loam, 15 to 25 percent slopes	7.6	0.9%
31D	Myersville-Catoctin silt loams, 15 to 25 percent slopes, very stony	12.5	1.4%
31E	Myersville-Catoctin silt loams, 25 to 65 percent slopes, very stony	36.3	4.2%
32C	Myersville and Montalto soils, 7 to 15 percent slopes, very stony	19.2	2.2%
32D	Myersville and Montalto soils, 15 to 25 percent slopes, very stony	122.6	14.2%
32E	Myersville and Montalto soils, 25 to 65 percent slopes, very stony	135.7	15.8%
W	Water	1.1	0.1%
Totals for Area of Interest		**861.7**	**100.0%**

Warren County, Virginia - 19B—Hawksbill cobbly loam, 2 to 7 percent slopes, occasionally flooded: Map Unit Setting Mean annual precipitation: 29 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 125 to 180 days **Map Unit Composition** Hawksbill and similar soils: 85 percent Minor components: 5 percent **Description of Hawksbill Setting** Landform: Fans Landform position (two-dimensional): Footslope Landform position (three-dimensional): Mountainbase, tread Down-slope shape: Linear Across-slope shape: Concave Parent material: Formed in weathered products of greenstone and sandstone **Properties and qualities** Slope: 2 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 high to high (0.57 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Occasional Frequency of ponding: None Available water capacity: Low (about 5.2 inches) **Interpretive groups** Land capability (nonirrigated): 3s **Typical profile** 0 to 6 inches: Cobbly loam 6 to 25 inches: Gravelly clay loam 25 to 47 inches: Very cobbly clay loam 47 to 60 inches: Very cobbly clay loam **Minor Components Purdy** Percent of map unit: 5 percent Landform: Backswamps on stream terraces Landform position (two-dimensional): Toeslope Landform position (three-dimensional): Tread Down-slope shape: Concave Across-slope shape: Concave

Warren County, Virginia - 20C—Hawksbill very cobbly loam, 7 to 15 percent slope, occasionally flooded: Map Unit Setting Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Hawksbill and similar soils: 90 percent **Description of**

Hawksbill Setting Landform: Fans Landform position (two-dimensional): Footslope Landform position (three-dimensional): Mountainbase, tread Down-slope shape: Linear, convex Across-slope shape: Concave, convex Parent material: Formed in weathered products of greenstone, sandstone and phyllite **Properties and qualities** Slope: 7 to 15 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 (0.57 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Occasional Frequency of ponding: None Available water capacity: Low (about 5.2 inches) **Interpretive groups** Land capability (nonirrigated): 6s **Typical profile** 0 to 6 inches: Very cobbly loam 6 to 25 inches: Gravelly clay loam 25 to 47 inches: Very cobbly clay loam 47 to 60 inches: Very cobbly clay loam

Warren County, Virginia - 21D—Lew channery loam, 7 to 25 percent slopes: Map Unit Setting Elevation: 1,800 to 3,000 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Lew and similar soils: 85 percent **Description of Lew Setting** Landform: Fans Landform position (two-dimensional): Footslope Landform position (three-dimensional): Mountainbase Down-slope shape: Linear Across-slope shape: Convex Parent material: Formed in weathered products of greenstone **Properties and qualities** Slope: 7 to 25 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 (0.57 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.3 inches) **Interpretive groups** Land capability (nonirrigated): 4e **Typical profile** 0 to 12 inches: Channery loam 12 to 60 inches: Very channery clay loam

Warren County, Virginia - 22E—Lew loam, 25 to 65 percent slopes, very stony: Map Unit Setting Elevation: 1,800 to 3,000 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Lew and similar soils: 90 percent **Description of Lew Setting** Landform: Drainageways Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Formed in weathered products of greenstone **Properties and qualities** Slope: 25 to 65 percent Surface area covered with cobbles, stones or boulders: 2.0 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 (0.57 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.3 inches) **Interpretive groups** Land capability (nonirrigated): 7e **Typical profile** 0 to 12 inches: Channery loam 12 to 60 inches: Very channery clay loam

Warren County, Virginia - 29C—Montalto loam, 7 to 15 percent slopes: Map Unit Setting Elevation: 80 to 2,000 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Montalto and similar soils: 80 percent **Description of Montalto Setting** Landform: Mountain slopes Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum derived from weatherted greenstone **Properties and qualities** Slope: 7 to 15 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 (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.5 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 6 inches: Gravelly loam 6 to 20 inches: Silty clay loam 20 to 52 inches: Silty clay 52 to 60 inches: Silt loam

Warren County, Virginia - 32C—Myersville and Montalto soils, 7 to 15 percent slopes, very stony: Map Unit Setting Elevation: 300 to 2,800 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Myersville and similar soils: 50 percent Montalto and similar soils: 40 percent **Description of Myersville Setting** Landform: Mountain slopes Landform position (three-dimensional): Mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from greenstone **Properties and qualities** Slope: 7 to 15 percent Surface area covered with cobbles, stones or boulders: 2.0 percent Depth to restrictive feature: 40 to 60 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.4 inches) **Interpretive groups** Land capability (nonirrigated): 6s **Typical profile** 0 to 6 inches: Silt loam 6 to 16 inches: Silty clay loam 16 to 39 inches: Channery silty clay loam 39 to 60 inches: Bedrock **Description of Montalto Setting** Landform: Mountain slopes Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from greenstone **Properties and qualities** Slope: 7 to 15 percent Surface area covered with cobbles, stones or boulders: 2.0 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 (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.5 inches) **Interpretive groups** Land capability (nonirrigated): 6s **Typical profile** 0 to 6 inches: Gravelly loam 6 to 20 inches: Silty clay loam 20 to 52 inches: Silty clay 52 to 60 inches: Silt loam

Warren County, Virginia - 32D—Myersville and Montalto soils, 15 to 25 percent slopes, very stony: Map Unit Setting Elevation: 300 to 2,800 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Myersville and similar soils: 50 percent Montalto and similar soils: 40 percent **Description of Myersville Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from greenstone **Properties and qualities** Slope: 15 to 25 percent Surface area covered with cobbles, stones or boulders: 2.0 percent Depth to restrictive feature: 40 to 60 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.4 inches) **Interpretive groups** Land capability (nonirrigated): 6s **Typical profile** 0 to 6 inches: Silt loam 6 to 16 inches: Silty clay loam 16 to 39 inches: Channery silty clay loam 39 to 60 inches: Bedrock **Description of Montalto Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Residuum weatherd from greenstone **Properties and qualities** Slope: 15 to 25 percent Surface area covered with cobbles, stones or boulders: 2.0 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 (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.5 inches) **Interpretive groups** Land capability (nonirrigated): 7s **Typical profile** 0 to 6 inches: Gravelly loam 6 to 20 inches: Silty clay loam 20 to 52 inches: Silty clay 52 to 60 inches: Silt loam

Warren County, Virginia - 32E—Myersville and Montalto soils, 25 to 65 percent slopes, very stony: Map Unit Setting Elevation: 300 to 2,800 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Myersville and similar soils: 50 percent Montalto and similar soils: 40 percent **Description of Myersville Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Residuum weathered from greenstone **Properties and qualities** Slope: 25 to 65 percent Surface area covered with cobbles, stones or boulders: 2.0 percent Depth to restrictive feature: 40 to 60 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.4 inches) **Interpretive groups** Land capability (nonirrigated): 7e **Typical profile** 0 to 6 inches: Silt loam 6 to 16 inches: Silty clay loam 16 to 39 inches: Channery silty clay loam 39 to 60 inches: Bedrock **Description of Montalto Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Greenstone **Properties and qualities** Slope: 25 to 65 percent Surface area covered with cobbles, stones or boulders: 2.0 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 (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.5 inches) **Interpretive groups** Land capability (nonirrigated): 7s **Typical profile** 0 to 6 inches: Gravelly loam 6 to 20 inches: Silty clay loam 20 to 52 inches: Silty clay 52 to 60 inches: Silt loam

Warren County, Virginia - 30C—Myersville silt loam, 7 to 15 percent slopes: Map Unit Setting Elevation: 800 to 2,800 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Myersville and similar soils: 80 percent **Description of Myersville Setting** Landform: Mountain slopes Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum derived from weathered greenstone **Properties and qualities** Slope: 7 to 15 percent Surface area covered with cobbles, stones or boulders: 2.0 percent Depth to restrictive feature: 40 to 60 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.4 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 6 inches: Silt loam 6 to 16 inches: Silty clay loam 16 to 39 inches: Channery silty clay loam 39 to 60 inches: Bedrock

Warren County, Virginia - 30D—Myersville silt loam, 15 to 25 percent slopes: Map Unit Setting Elevation: 800 to 2,800 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Myersville and similar soils: 80 percent **Description of Myersville Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Residuum rerives from greenstone **Properties and qualities** Slope: 15 to 25 percent Depth to restrictive feature: 40 to 60 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.4 inches) **Interpretive groups** Land capability (nonirrigated): 4e **Typical profile** 0 to 6 inches: Silt loam 6 to 16 inches: Silty clay loam 16 to 39 inches: Channery silty clay loam 39 to 60 inches: Bedrock

Warren County, Virginia - 31D—Myersville-Catoctin silt loams, 15 to 25 percent slopes, very stony: Map Unit Setting Elevation: 500 to 2,800 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Myersville and similar soils: 50 percent Catoctin and similar soils: 40 percent **Description of Myersville Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Residuum derived from greenstone **Properties and qualities** Slope: 15 to 25 percent Surface area covered with cobbles, stones or boulders: 2.0 percent Depth to restrictive feature: 40 to 60 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.4 inches) **Interpretive groups** Land capability (nonirrigated): 6s **Typical profile** 0 to 6 inches: Silt loam 6 to 16 inches: Silty clay loam 16 to 39 inches: Channery silty clay loam 39 to 60 inches: Bedrock **Description of Catoctin Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Residuum derived from greenstone **Properties and qualities** Slope: 15 to 25 percent Surface area covered with cobbles, stones or boulders: 2.0 percent Depth to restrictive feature: 20 to 40 inches to lithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Very low (about 2.6 inches) **Interpretive groups** Land capability (nonirrigated): 7s **Typical profile** 0 to 5 inches: Silt loam 5 to 13 inches: Channery silt loam 13 to 24 inches: Very channery silt loam 24 to 34 inches: Bedrock

Warren County, Virginia - 31E—Myersville-Catoctin silt loams, 25 to 65 percent slopes, very stony: Map Unit Setting Elevation: 500 to 2,800 feet Mean annual precipitation: 38 to 46 inches Mean annual air temperature: 46 to 59 degrees F Frost-free period: 140 to 170 days **Map Unit Composition** Myersville and similar soils: 50 percent Catoctin and similar soils: 45 percent **Description of Myersville Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Residuum weathered from greenstone **Properties and qualities** Slope: 25 to 65 percent Surface area covered with cobbles, stones or boulders: 2.0 percent Depth to restrictive feature: 40 to 60 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.4 inches) **Interpretive groups** Land capability (nonirrigated): 7e **Typical profile** 0 to 6 inches: Silt loam 6 to 16 inches: Silty clay loam 16 to 39 inches: Channery silty clay loam 39 to 60 inches: Bedrock **Description of Catoctin Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex Parent material: Residuum derived from greenstone **Properties and qualities** Slope: 25 to 65 percent Surface area covered with cobbles, stones or boulders: 2.0 percent Depth to restrictive feature: 20 to 40 inches to lithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Very low (about 2.6 inches) **Interpretive groups** Land capability (nonirrigated): 7e **Typical profile** 0 to 5 inches: Silt loam 5 to 13 inches: Channery silt loam 13 to 24 inches: Very channery silt loam 24 to 34 inches: Bedrock

Warren County, Virginia - W—Water: Map Unit Composition Water: 100 percent

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.

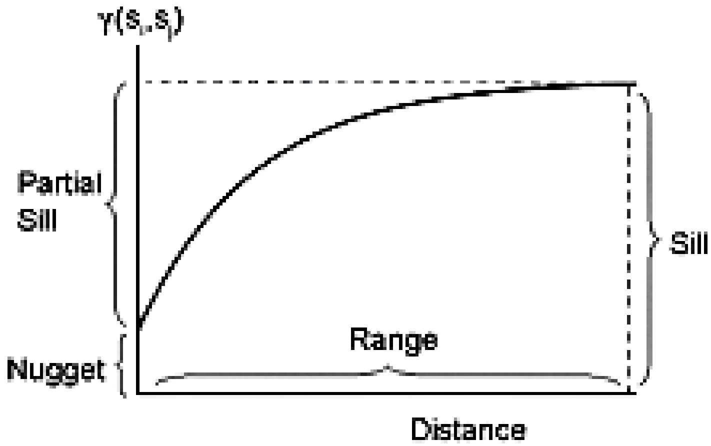


Figure 5. Example semivariogram, depicting range, sill, and nugget.

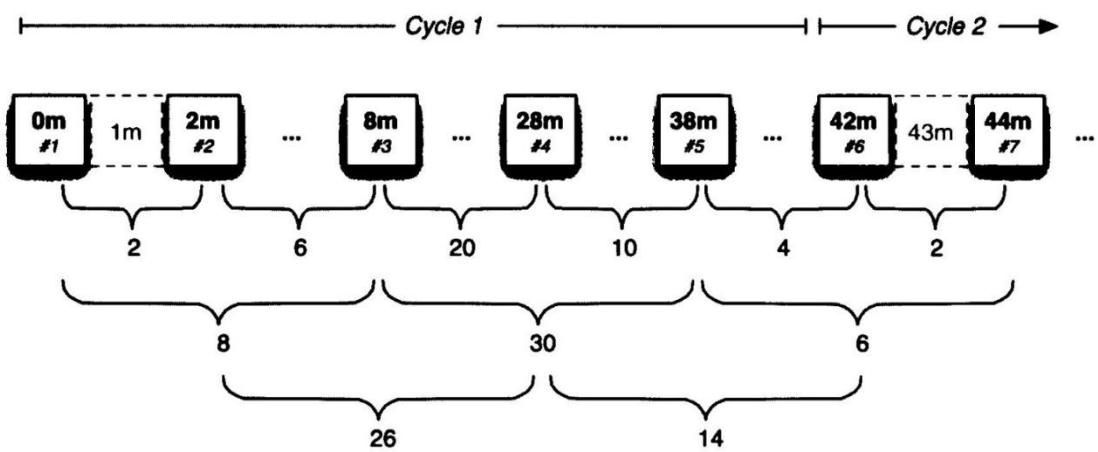


Figure 6. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 19 August 2010 at the SCBI 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 (168 m, 84 m, and 84 m) located in the expected airshed at SCBI. 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. 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 and any remaining time of day trend, 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 graphs) 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 12 m for soil temperature.

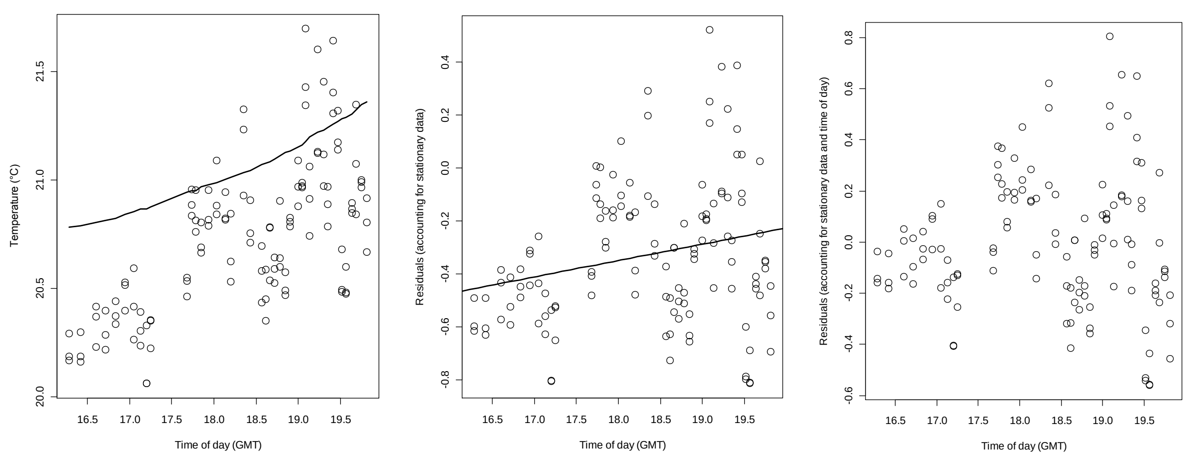


Figure 7. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting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

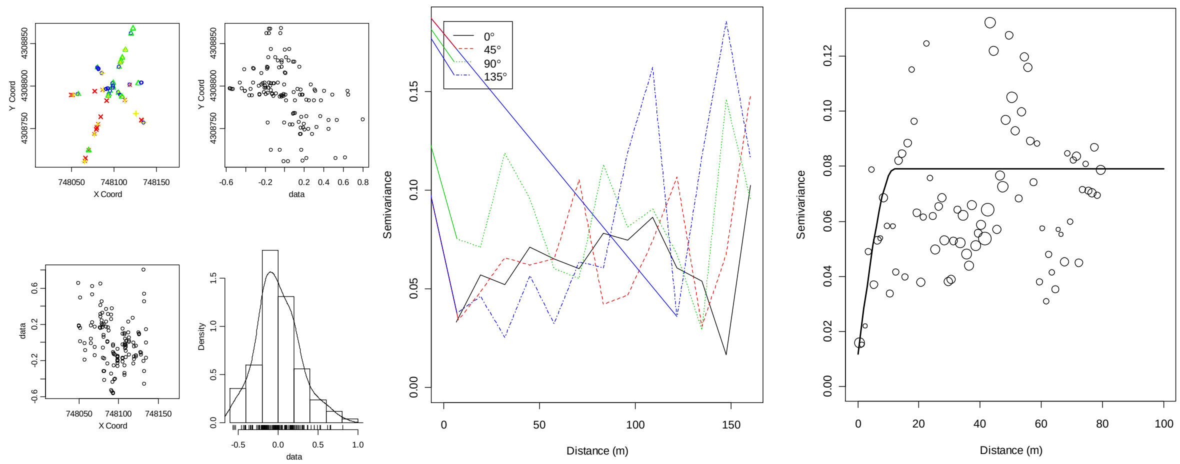


Figure 8. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

3.3.3.2 Soil water content

Soil water content data residuals, after accounting for changes in water content in the stationary data and any remaining time of day trend, were used for the semivariogram analysis (Figure 9). Exploratory data analysis plots show that there was some pattern in the residuals (Figure 10, top left graph), which breaks the assumprtion required for fitting a semivariogram. The directional semivariograms do not show anisotropy (Figure 10, top right graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 10, bottom left graph), but did not fit the data well. When the lag distance was limited to 60 m the semivariogram fitted well and the model indicated a distance of effective independence of 27 m for soil water content, but it should be noted that some assumptions have been breached.

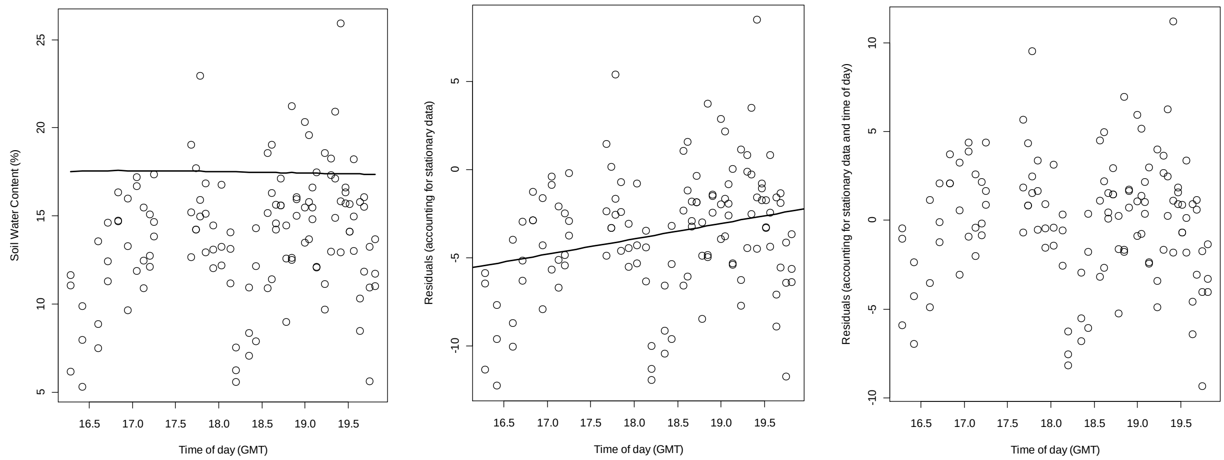


Figure 9. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting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

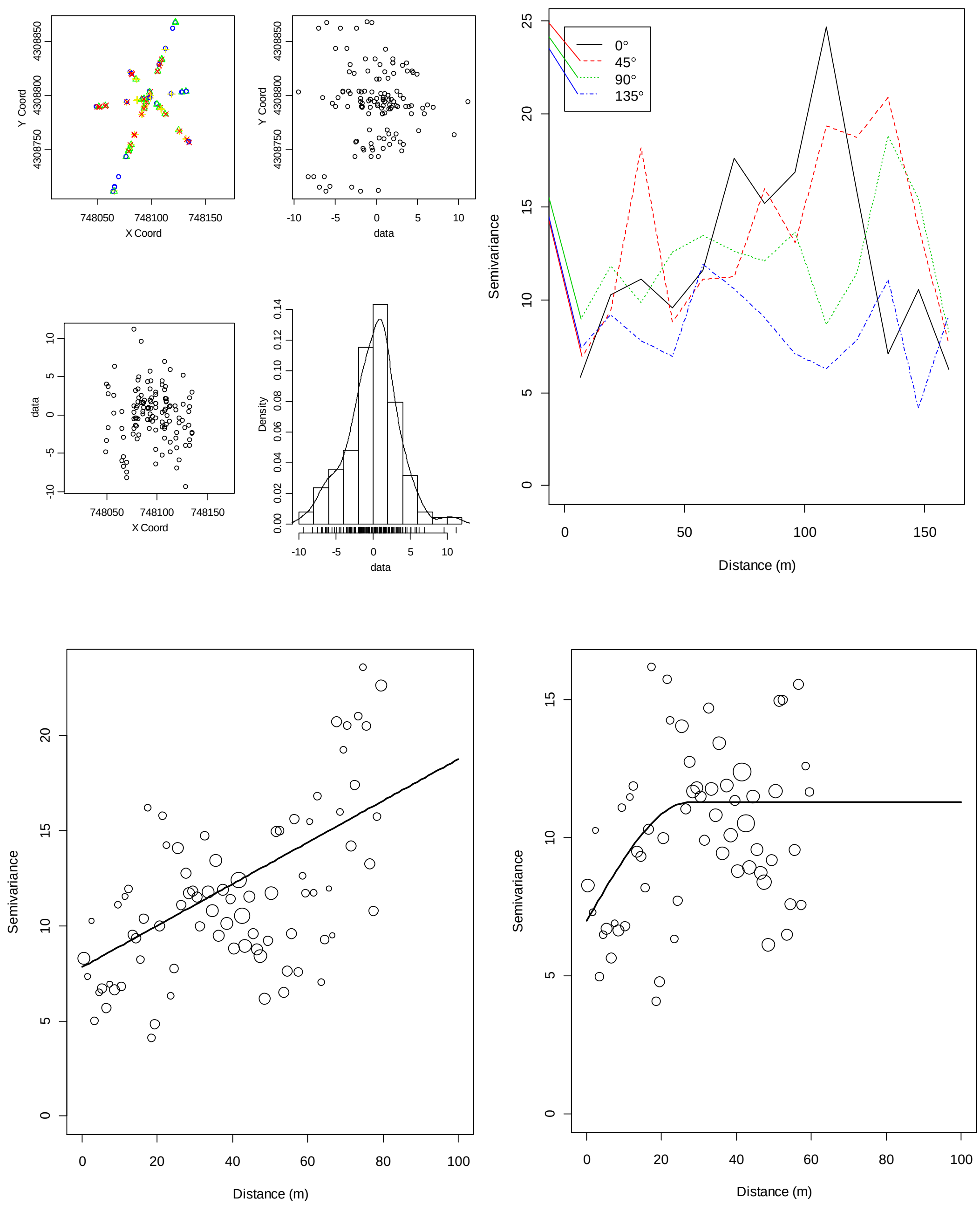


Figure 10. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

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 allowable between soil plots is 40 m due to cost constraints. The estimated distance of effective independence was 12 m for soil temperature, but remains uncertain for soil moisture (see above). Due to this uncertainty and based on the site design guidelines a conservative decision was made to place the soil plots 40 m apart at SCBI. 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 190° from the soil plot nearest the tower (i.e., first soil plot). The location of the first soil plot will be approximately 38.89280°, -78.13953°. The exact location of each soil plot will be chosen by an FIU team member during site construction 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 38.892188, -78.137691 (primary location); or 38.892677, -78.137752 (alternate location 1 if primary location is unsuitable); or 38.893073, -78.137945 (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 12.

Dominant soil series at the site: Lew loam, 25 to 65 percent slopes, very stony. The taxonomy of this soil is shown below:
Order: Alfisols
Suborder: Udalfs
Great group: Hapludalfs
Subgroup: Ultic Hapludalfs
Family: Loamy-skeletal, mixed, active, mesic Ultic Hapludalfs
Series: Lew loam, 25 to 65 percent slopes, very stony

Table 4. Summary of soil array and soil pit information at SCBI.
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	14 m
Latitude and longitude of 1st soil plot OR direction from tower	38.89280°, -78.13953°
Direction of soil array	190°
Latitude and longitude of FIU soil pit 1	38.892188, -78.137691 (primary location)
Latitude and longitude of FIU soil pit 2	38.892677, -78.137752 (alternate 1)
Latitude and longitude of FIU soil pit 3	38.893073, -78.137945 (alternate 2)
Dominant soil type	Lew loam, 25 to 65 percent slopes, very stony
Expected soil depth	>2 m
Depth to water table	>2 m

Expected depth of soil horizons	**Expected measurement depths***

0-0.30 m (Channery loam)	0.15 m
0.30-1.52 m (Very channery clay loam)	0.91 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.

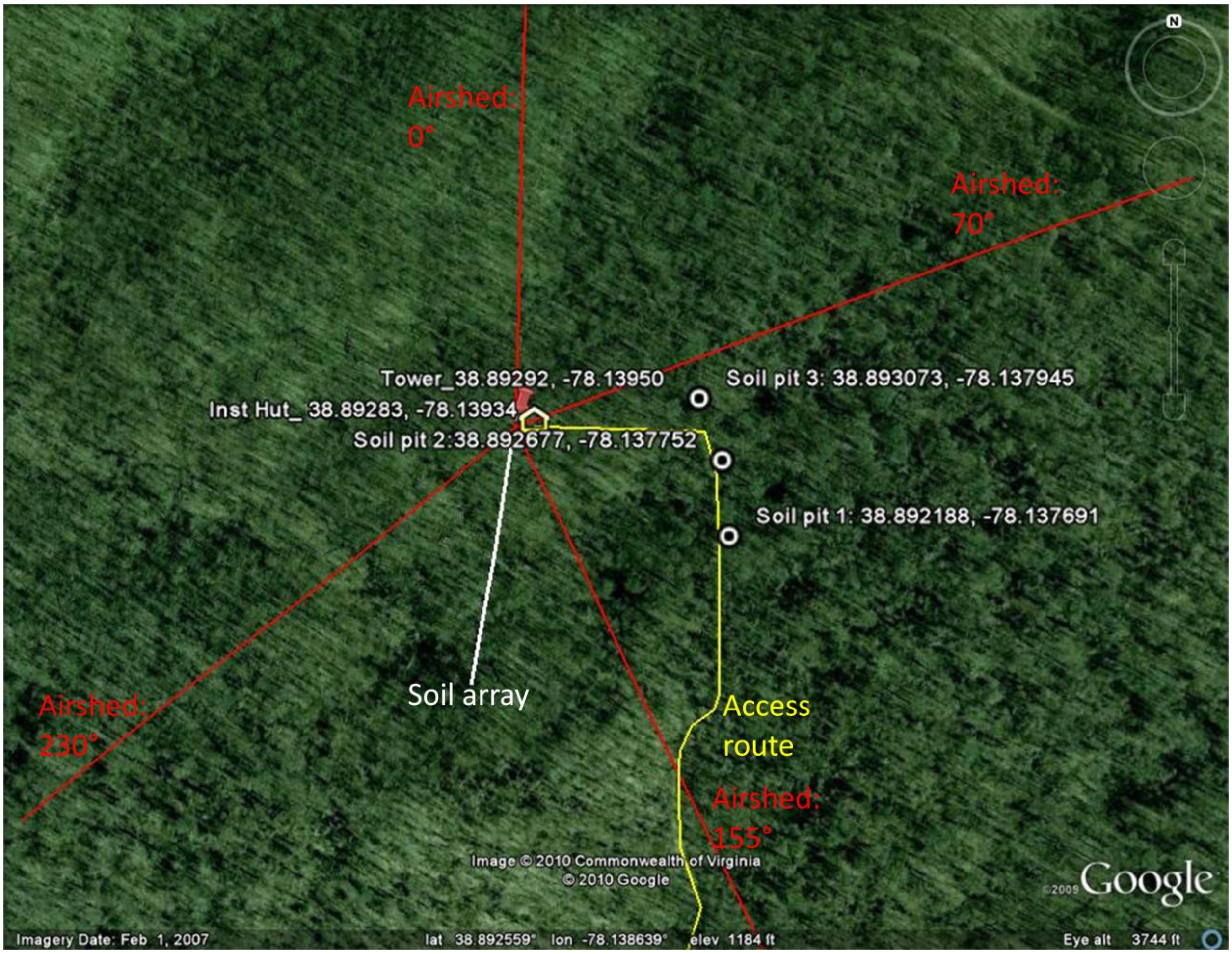


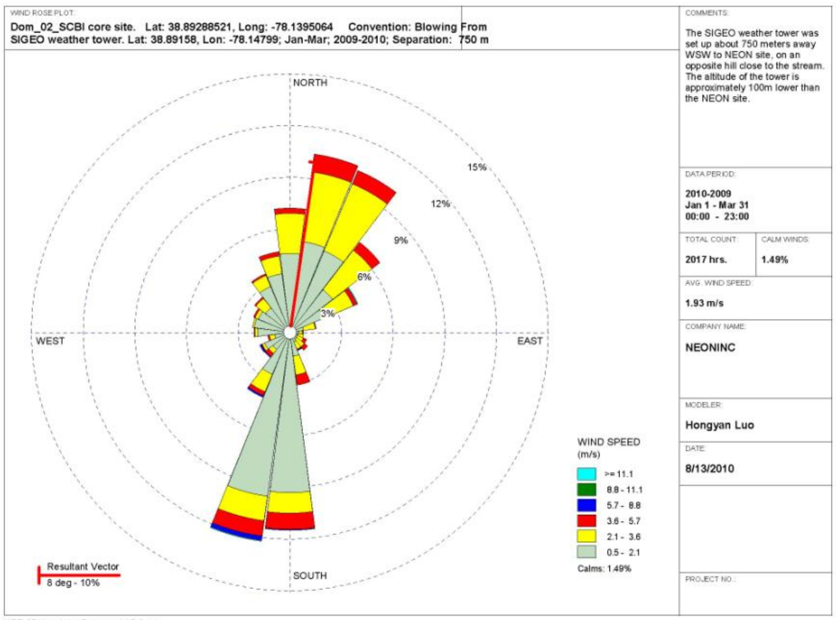
Figure 12. Site layout at SCBI showing soil array and location of the FIU soil pit.

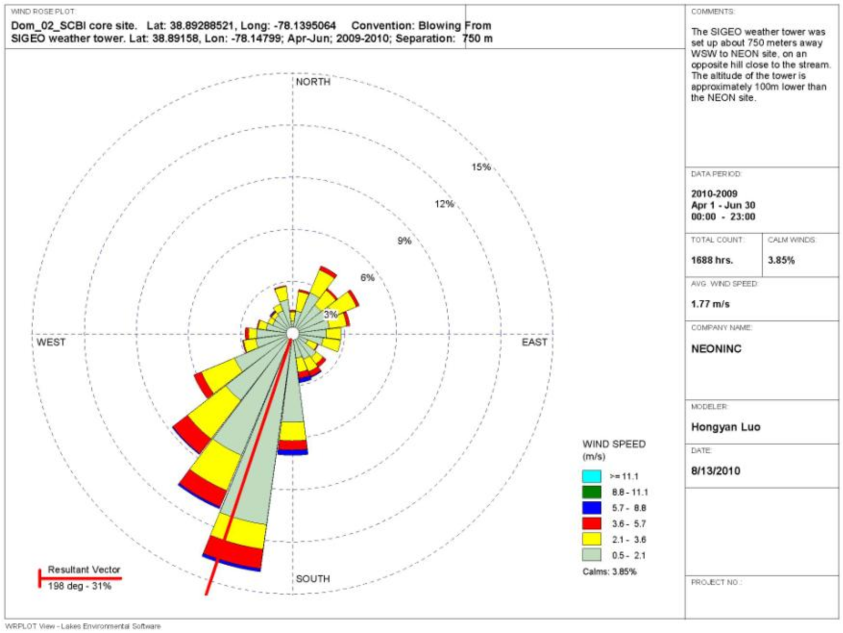
3.4 Airshed

3.4.1 Seasonal windroses

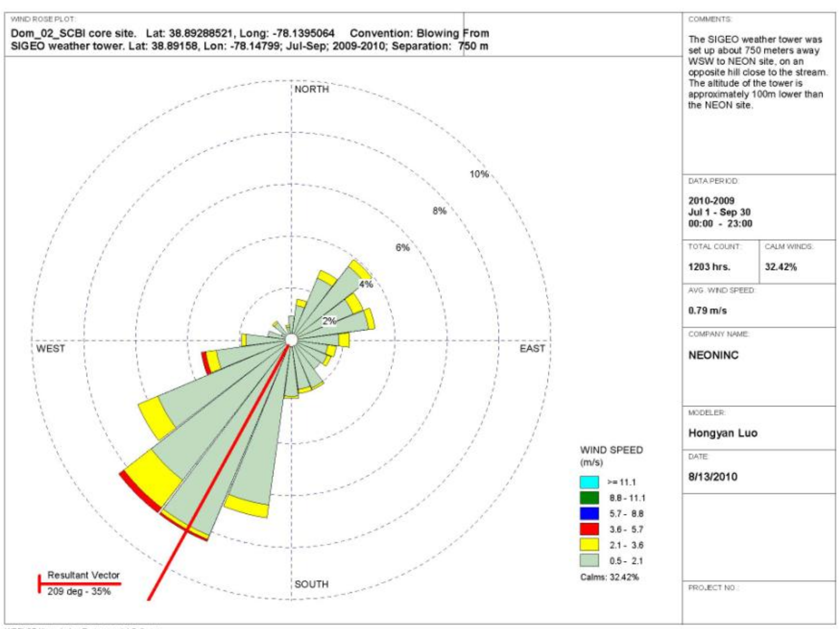
Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given timeseries, Figure 13. The weather data used to generate the following wind roses are from SIGEO weather tower (38.89158, -78.14799), which is ~750 m away WSW to NEON tower site. Data were provided by Dr Norman Bourg. Wind roses outputs from this dataset are similar to the wind roses from Dickey Ridge in Shenandoah National Park (Figure 14), which was suggested by SCBI during NEON site visit in 2008. 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.

3.4.2 Results (graphs for wind roses)





WIND ROSE PLOT:
Dom_02_SCBI core site. Lat: 38.89288521, Long: -78.1395064 Convention: Blowing From
SIGEO weather tower. Lat: 38.89158, Lon: -78.14799; Apr-Jun; 2009-2010; Separation: 750 m
NORTH
SOUTH
WEST
EAST
15%
12%
9%
6%
3%
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: 3.85%
Resultant Vector
198 deg - 31%
COMMENTS:
The SIGEO weather tower was set up about 750 meters away WSW to NEON site, on an opposite hill close to the stream. The altitude of the tower is approximately 100m lower than the NEON site.
DATA PERIOD:
2010-2009
Apr 1 - Jun 30
00:00 - 23:00
TOTAL COUNT:
1688 hrs.
CALM WINDS:
3.85%
AVG. WIND SPEED:
1.77 m/s
COMPANY NAME:
NEONINC
MODELER:
Hongyan Luo
DATE:
8/13/2010
PROJECT NO.:
WRPLOT View - Lakes Environmental Software



WIND ROSE PLOT:
Dom_02_SCBI core site. Lat: 38.89288521, Long: -78.1395064 Convention: Blowing From
SIGEO weather tower. Lat: 38.89158, Lon: -78.14799; Jul-Sep; 2009-2010; Separation: 750 m
NORTH
SOUTH
WEST
EAST
10%
8%
6%
4%
2%
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: 32.42%
Resultant Vector
209 deg - 35%
COMMENTS:
The SIGEO weather tower was set up about 750 meters away WSW to NEON site, on an opposite hill close to the stream. The altitude of the tower is approximately 100m lower than the NEON site.
DATA PERIOD:
2010-2009
Jul 1 - Sep 30
00:00 - 23:00
TOTAL COUNT:
1203 hrs.
CALM WINDS:
32.42%
AVG. WIND SPEED:
0.79 m/s
COMPANY NAME:
NEONINC
MODELER:
Hongyan Luo
DATE:
8/13/2010
PROJECT NO.:
WRPLOT View - Lakes Environmental Software

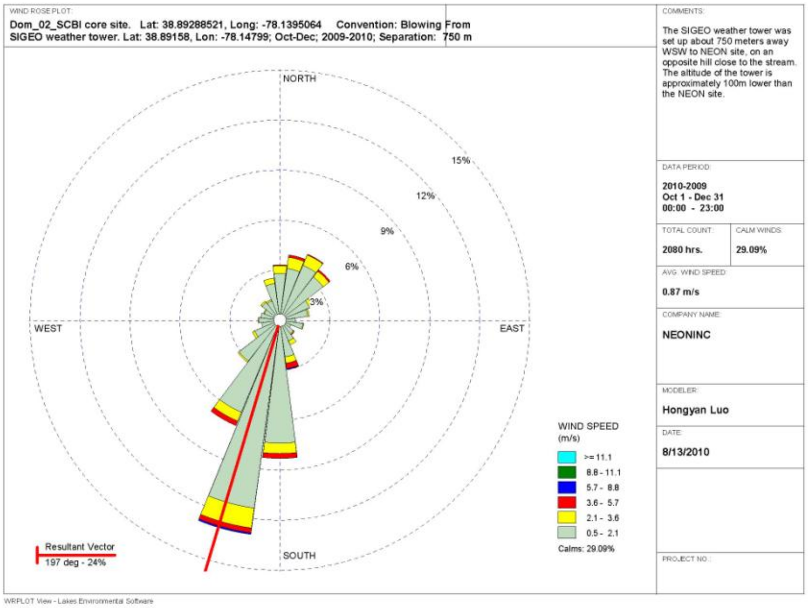
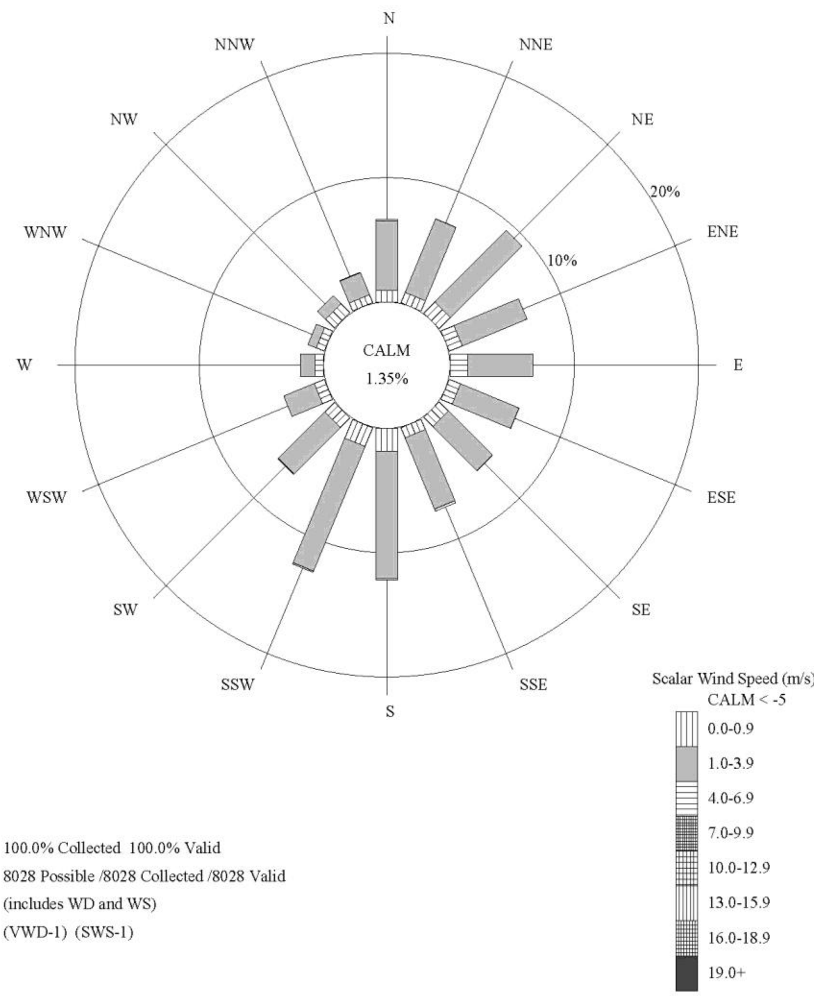


Figure 13. Windroses from the SIGEO weather station at SCBI.
Data used here are hourly data from 2009 to 2010. Data was collected and obtained from the SIGEO weather station at SCBI. It is assumed that the wind data was corrected for declination. Panels are (from top to bottom), Jan-Mar, Apr-Jun, Jul-Sept, and Oct-Dec.

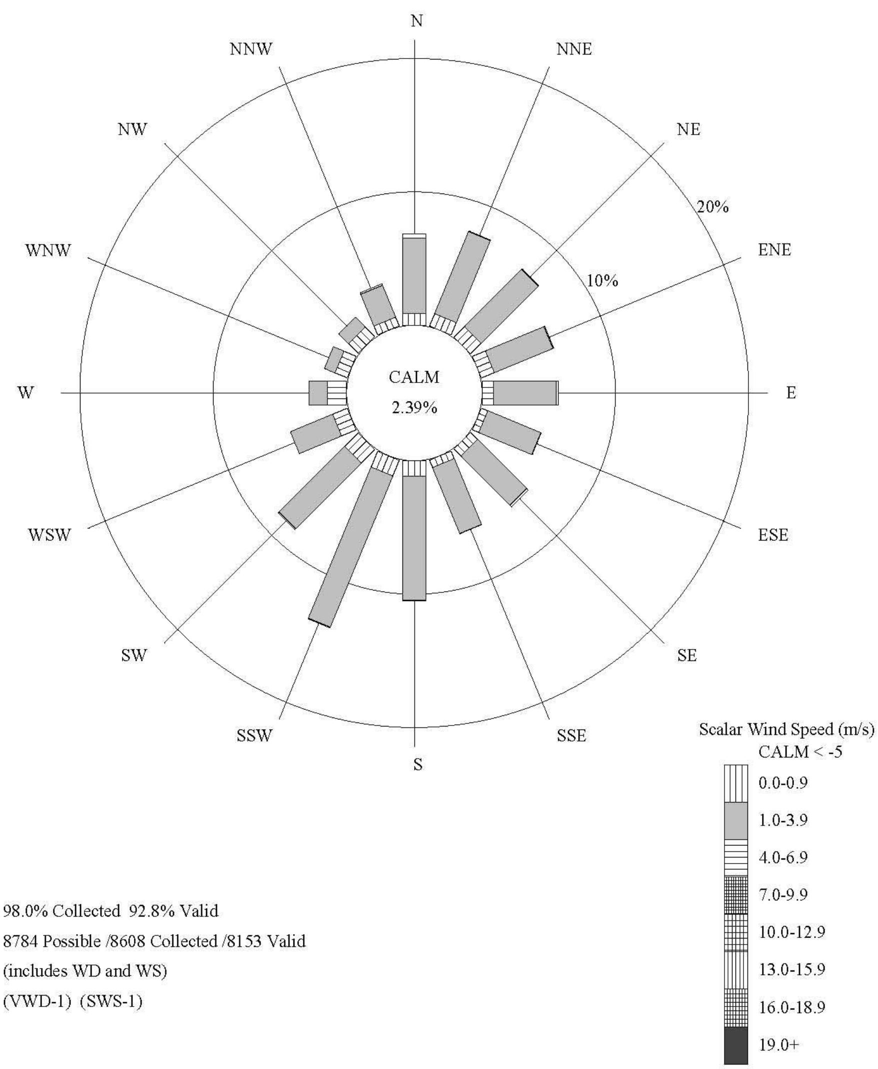
Shenandoah National Park Dickey Ridge — Wind Rose — 09/01/1989 - 09/01/1990



100.0% Collected 100.0% Valid
8028 Possible /8028 Collected /8028 Valid
(includes WD and WS)
(VWD-1) (SWS-1)

Final Validation — 04-17-2008

Shenandoah National Park Wind Rose 01/01/1993 - 01/01/1994
Dickey Ridge



98.0% Collected 92.8% Valid
8784 Possible /8608 Collected /8153 Valid
(includes WD and WS)
(VWD-1) (SWS-1)

Final Validation 04-17-2008

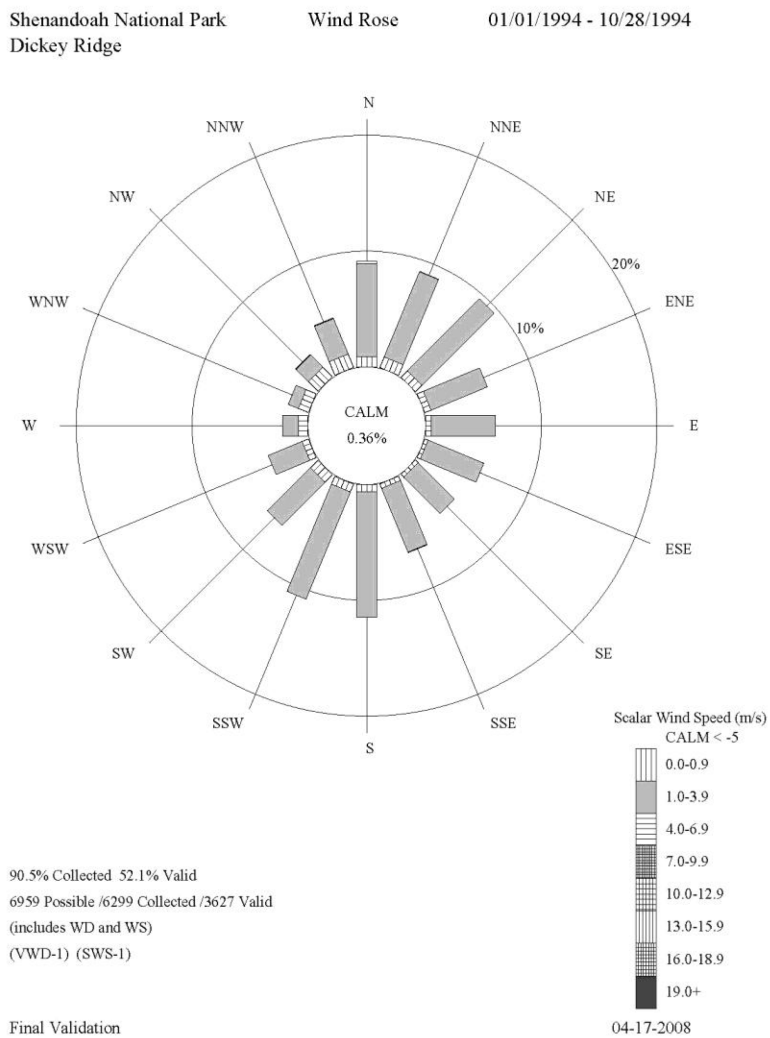


Figure 14. Windroses from Dickey Ridge in Shenandoah National Park.
Wind roses were provided by Dr Norm Bourg. It is assumed that the wind data was corrected for declination. Panels are (from top to bottom) wind roses for 09/1989-09/1990, 01/1993-01/1994 and 01/1994-10/1994.

3.4.3 Resultant vectors

Table 5. The resultant wind vectors from SIGEO weather station for SCBI core site using hourly data from 2009 to 2010

Quarterly (seasonal) timeperiod	Resultant vector	% duration
January to March	8°	10
April to June	198°	31
July to September	209°	35
October to December	197°	24
Annual	153°	na.

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 (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.

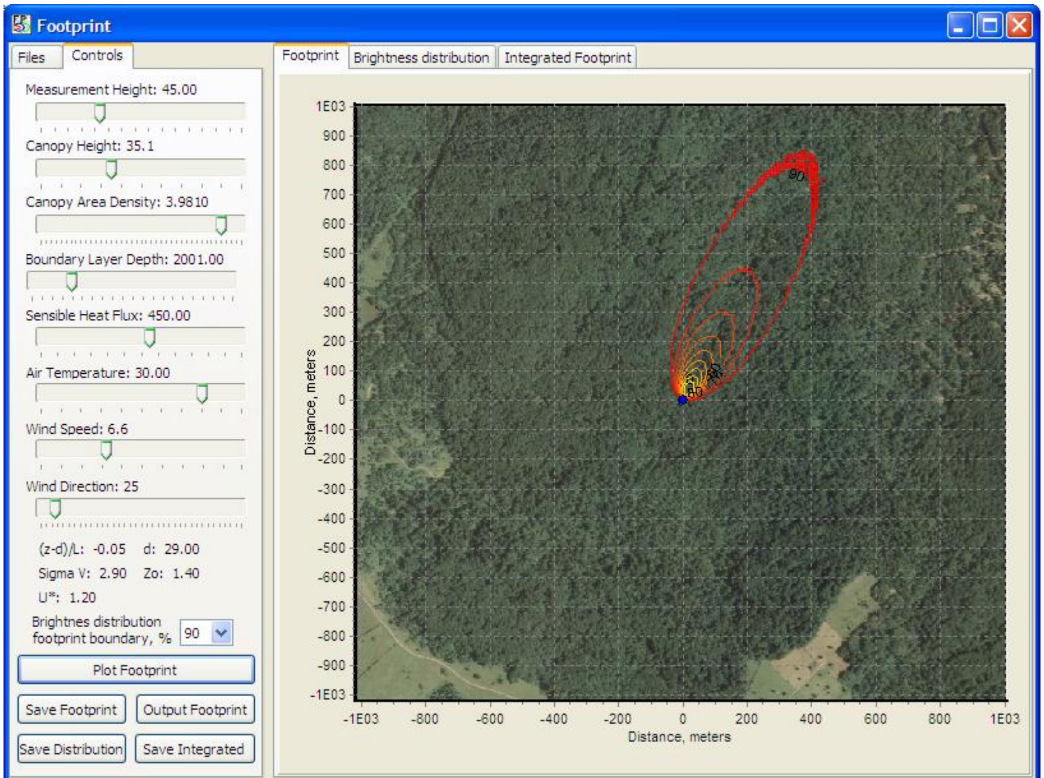
Here, we used a web-based footprint model to determine the footprint area under various conditions (model info: http://www.geos.ed.ac.uk/abs/research/micromet/EdiTools/). Winds used to run the model and generate following model results are extracted from the wind roses. Vegetation information, temperature 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 6. Expected environmental controls to parameterize the source area model, and associated results from SCBI 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	45	45	45	45	45	45	m
Canopy Height	35	35	35	35	35	35	m
Canopy area density	4.0	4.0	4.0	1.5	1.5	1.5	m
Boundary layer depth	2000	2000	900	900	900	700	m
Expected sensible heat flux	450	450	-25	180	180	-75	W m^{-2}
Air Temperature	30	30	20	1	1	1	°C
Max. windspeed	6.5	2.5	2.8	6.5	2.5	2.8	m s^{-1}
Resultant wind vector	25	250	205	25	25	205	degrees
Results							
(z-d)/L	-0.05	-0.28	0.08	-0.02	-0.18	2.40	m
d	29	29	29	25	25	25	m
Sigma v	2.90	2.20	1.80	2.60	1.60	1.60	m^2 s^{-2}
Z0	1.40	1.40	1.40	2.10	2.10	2.10	m
u*	1.20	0.66	0.40	1.20	0.62	0.19	m s^{-1}
Distance source area begins	0	0	0	0	0	100	m
Distance of 90% cumulative flux	700	250	1200	800	420	2500	m
Distance of 80% cumulative flux	400	180	600	480	250	1750	m
Distance of 70% cumulative flux	300	100	450	300	200	1300	m
Peak contribution	55	25	65	65	45	295	m

3.4.5 Results (source area graphs)



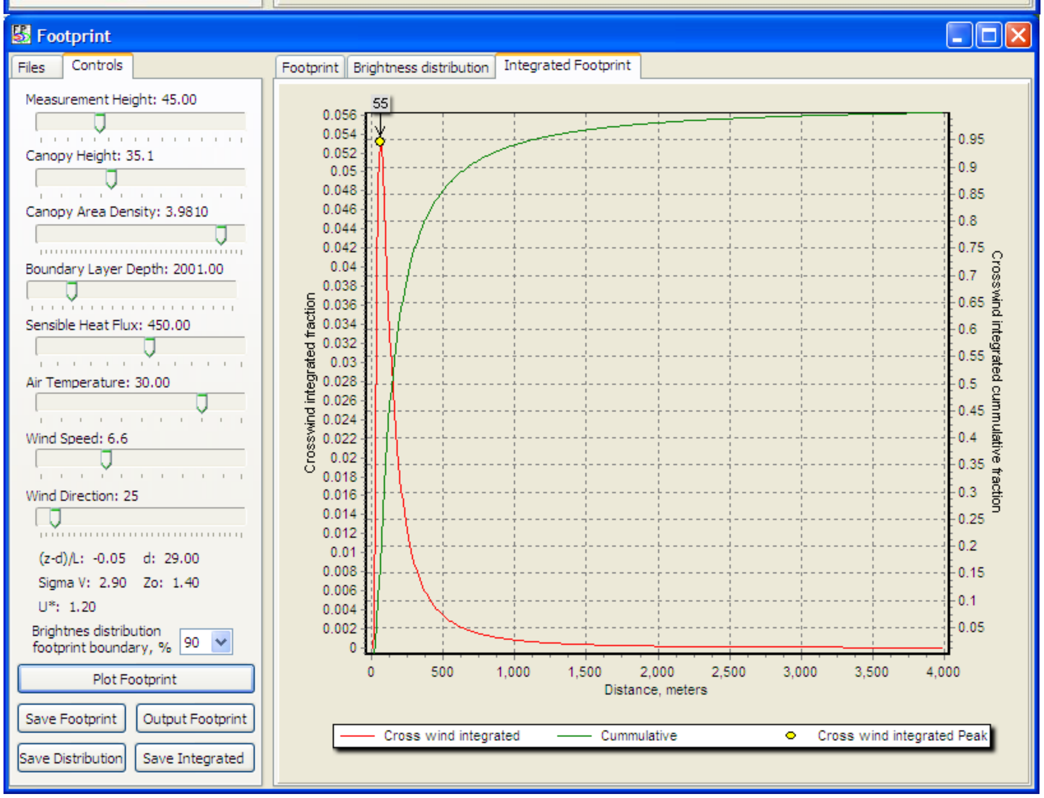


Figure 15. SCBI summer daytime (convective) footprint output with max wind speed.

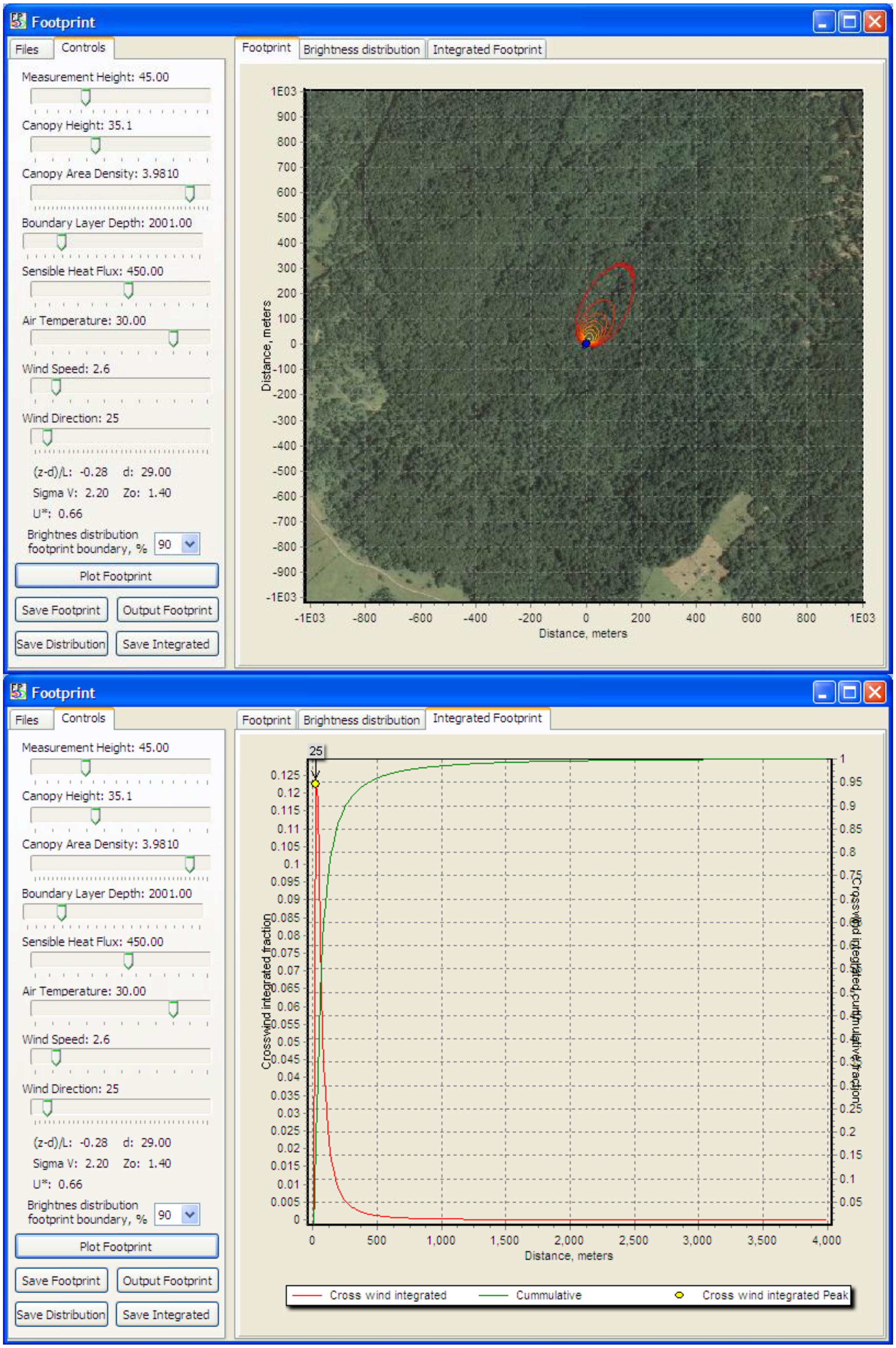


Figure 16. SCBI summer daytime (convective) footprint output with mean wind speed.

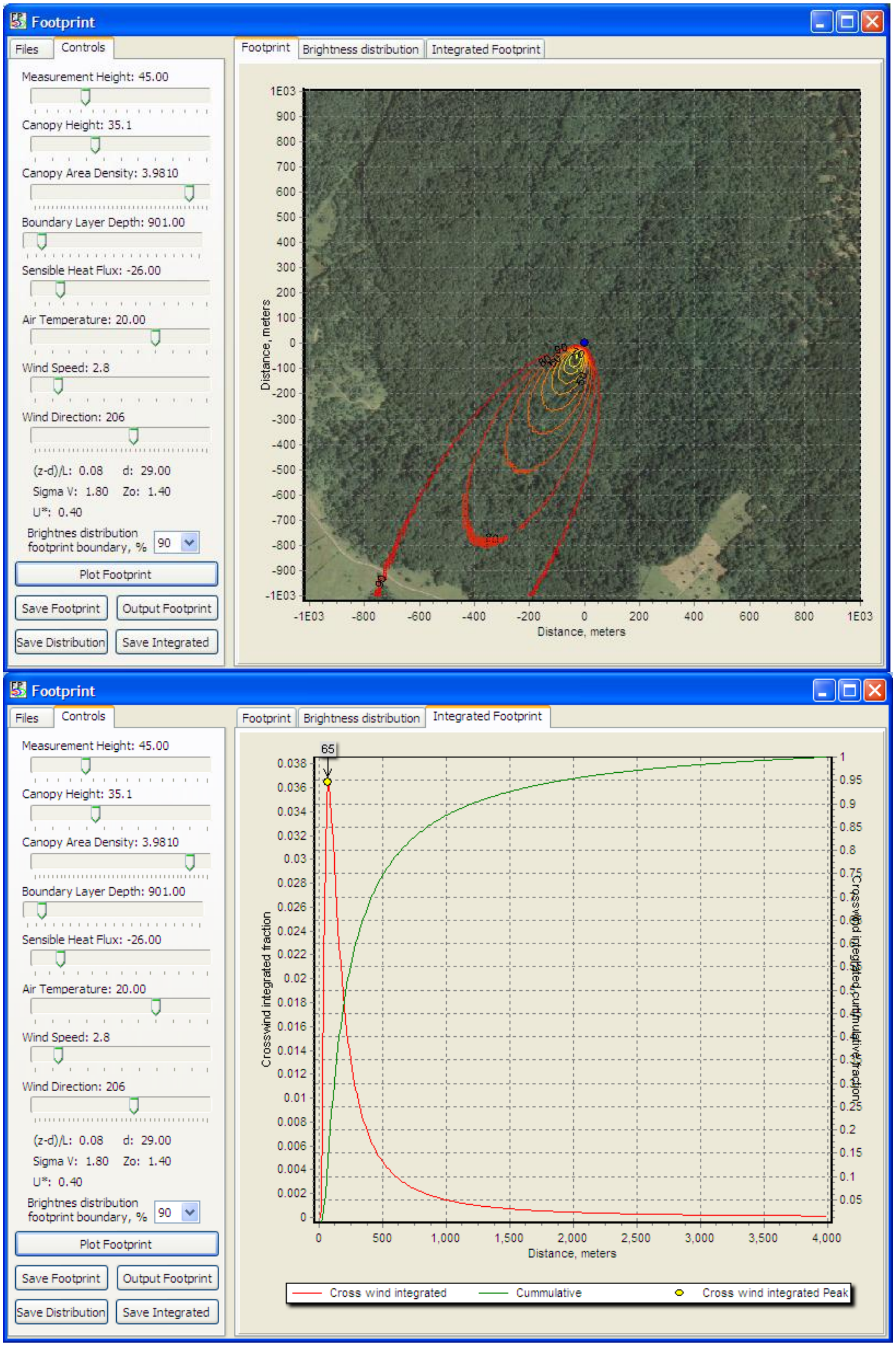


Figure 17. SCBI summer nighttime (stable) footprint output with mean wind speed.

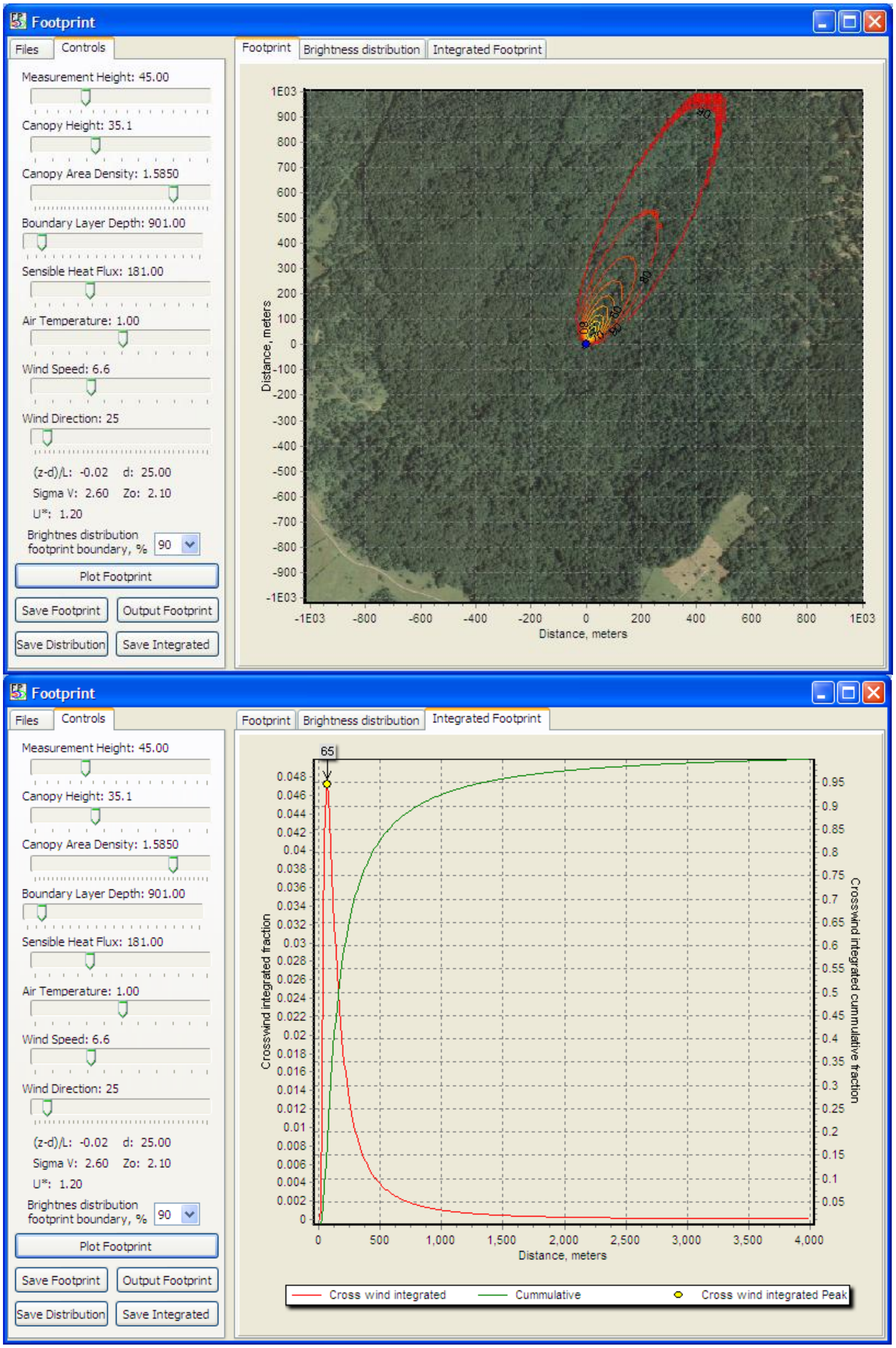


Figure 18. SCBI winter daytime (convective) footprint output with max wind speed.

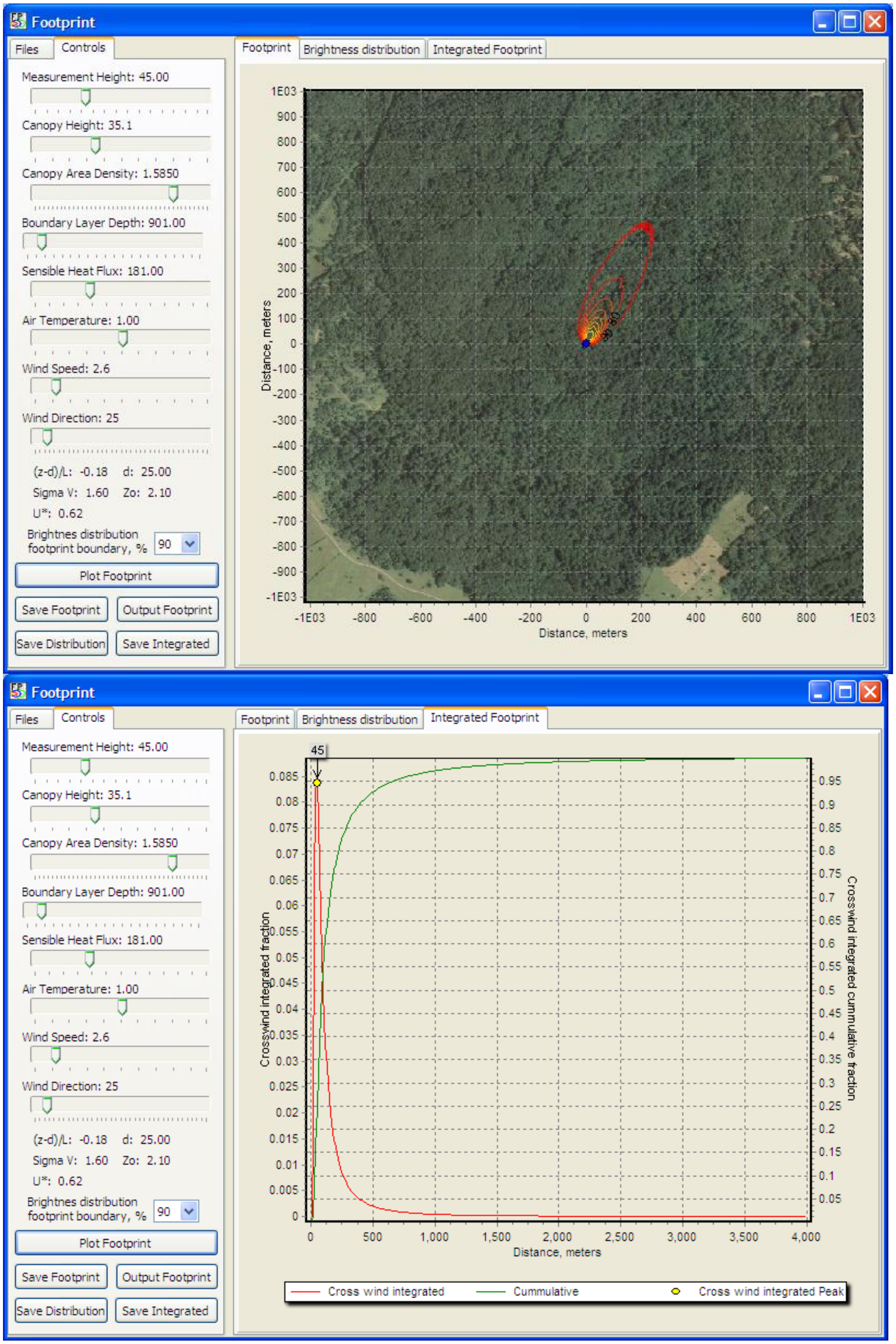


Figure 19. SCBI winter daytime (convective) footprint output with mean wind speed.

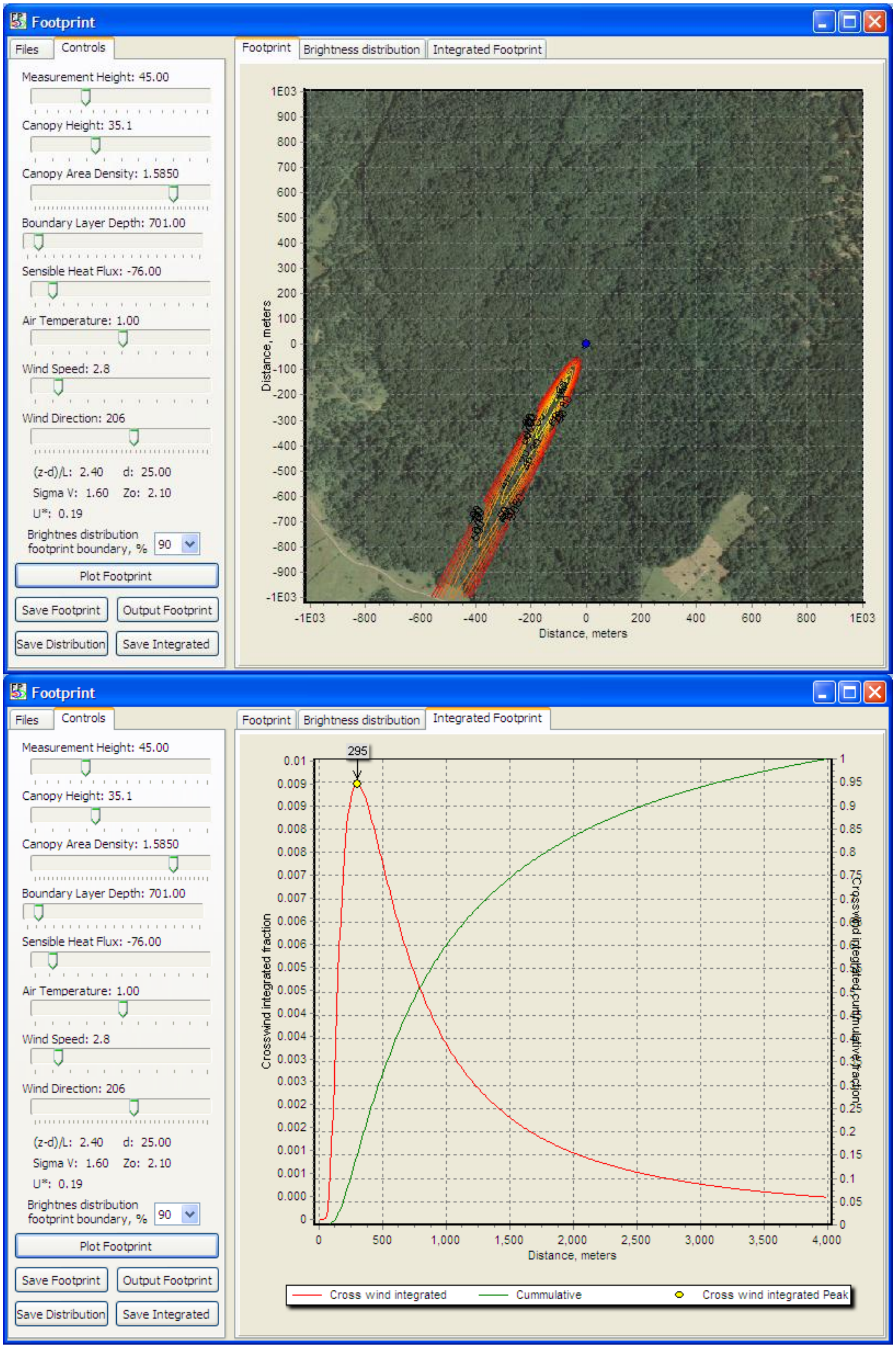


Figure 20. SCBI winter nighttime (stable) footprint output with mean wind speed.

3.4.6 Site design and tower attributes

According to wind roses, the prevailing wind direction blows from northwest to Northeast (0^o to 70^o, clockwise from 0^o) and from south (155^o to 230^o, clock wise from 155^o) throughout the year. Tower should be placed to a location to best catch the signals from the airshed of the ecosystem of interest, which is eastern deciduous mixed (tulip popular-oaks-black walnut) forest. The tower site on EHS' list is 38.892885, -78.139506, which was converted from the northing and easting coordinates in the previous site visit in 2008. We were told that an error was possibly introduced during conversion. During FIU site characterization, we found the same tower location and re-measured the GPS points, which are 38.89292, -78.13950.

Eddy covariance, sonic wind and air temperature **boom arms** orientation toward the NW will be best to capture signals from all major wind directions, including the downhill flows. **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 northwest side of tower and have the longer side parallel to NE-SW direction. Because this is a closed canopy ecosystem, the distance between the tower and the instrument hut can be reduced to ~ 15 m. Therefore, we require the placement of instrument hut at 38.89297, -78.13966. Instrument hut is placed on the downhill side of tower to avoid the interference to the airflows that drain from uphill slop.

Canopy height is ~35 m around tower site with lowest branches at ~7 m. Oak, ash and other tree species form upper understory with height ~ 8 m. Berry vines (species unknown) form the middle understory with mean height ~ 1.2 m. New ash seedlings and grasses form the understory at ground level with height ~ 0.3 m. Plants of the top and middle understory appear to be randomly distributed. The vegetation at ground level is very dense and carpets the forest floor. We require 6 **measurement layers** on the tower with top measurement height at 50 m, and rest of the layers at 38 m, 29 m, 17 m, 7 m and 0.2 m, respectively, to best characterize the fluxes on the tower top and environmental conditions in profile.

DFIR (Double Fenced International Reference) will be used for bulk precipitation collection. We had difficulty to find adequate open area to meet USCRN class 1 and class 2 criteria for DFIR within 500 m radius from tower. The best and closest open area we can find is on the northwest side of tower and ~1.2 km away from tower and on a small hill top, which is next to access road and power line (< 100 m). It is in the same watershed with tower site. Coordinates are 38.89755, -78.15170. There are 3 – 4 small trees at the DFIR location. Dr Norman Bourg said it is no problem to remove these trees. After this tree removal, the open area will meet USCRN class 1 criteria for DFIR. **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. 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, in this case, level 6 being the upper most level at this tower site.

Table 7. Site design and tower attributes for SCBI 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			0° to 70° and 155° to 230°		Clockwise from first angle
Tower location	38.89292	-78.13950	--	--	Same location, new coordinates
Instrument hut	38.89283	-78.13934			
Instrument hut orientation vector	--	--	30° - 210°		
Instrument hut distance z	--	--	--	15	
Anemometer/Temperature boom orientation	--	--	300°	--	
DFIR	38.89755	-78.15170			
Height of the measurement levels					
Level 1				0.2	m.a.g.l.
Level 2				7.0	m.a.g.l.
Level 3				17.0	m.a.g.l.
Level 4				29.0	m.a.g.l.
Level 5				38.0	m.a.g.l.
Level 6				50.0	m.a.g.l.
Tower Height				50.0	m.a.g.l.

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

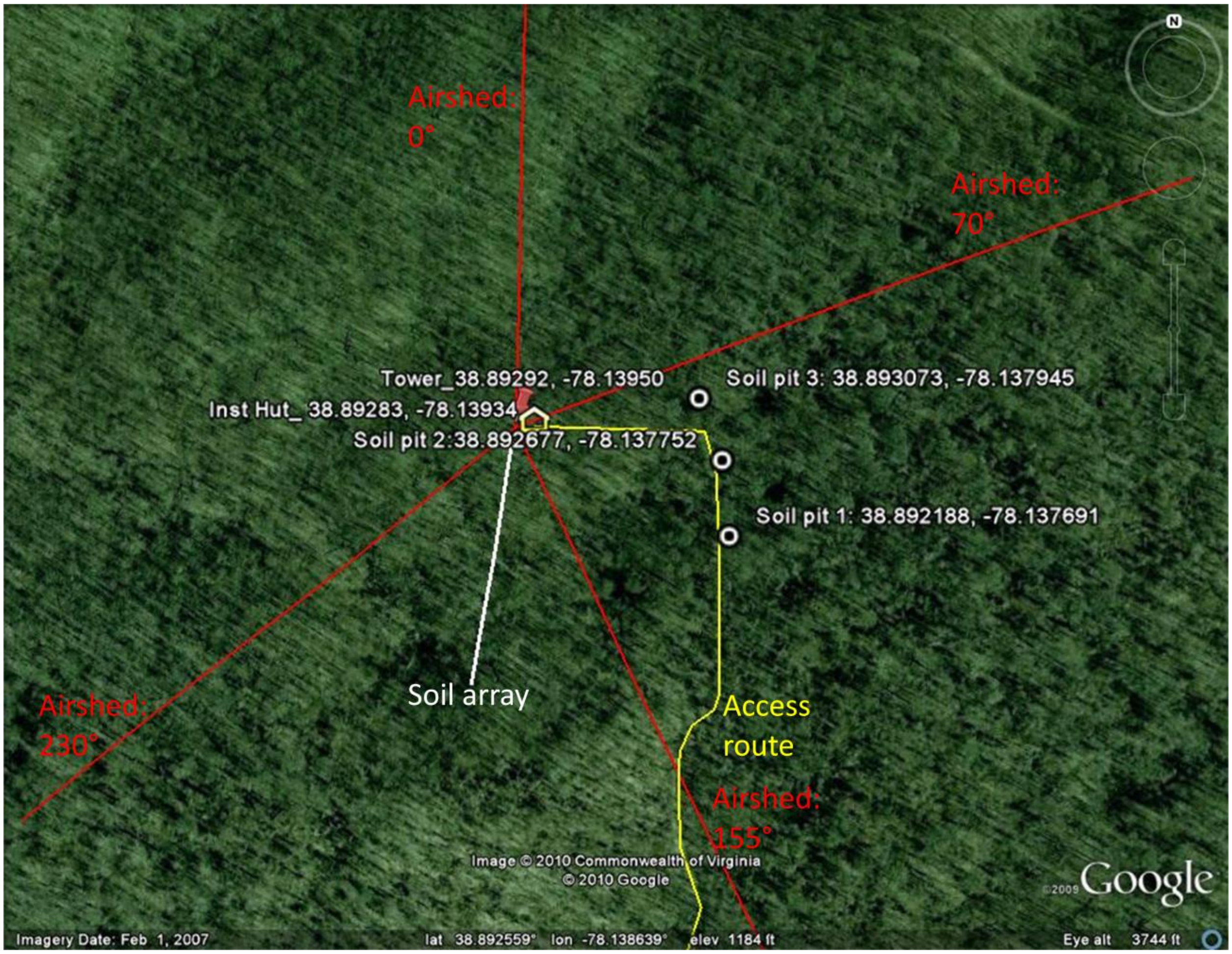


Figure 21. Site layout for SCBI Advanced tower site.

i) Tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 0^o to 70^o (clockwise from 0^o) and 155^o to 230^o (clock wise from 155^o) are the airshed area that would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut.

Figure 22. DFIR location at SCBI tower site.
Purple pin indicates the DFIR location, which is close to access road and power line. It is~ 1.2 km away from tower location, but in the same watershed.

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" (0.914 m). wide footprint. The boardwalk to access the tower is not on any side that has a boom.
Specific Boardwalks at SCBI site

- Boardwalk is from the access dirt road to instrument hut. SCBI does not have regulation on boardwalk usage.
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- Boardwalk required from tower or instrument hut to soil array.
- No boardwalk from the soil array boardwalk to the individual soil plots
- No boardwalk needed at DFIR site

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

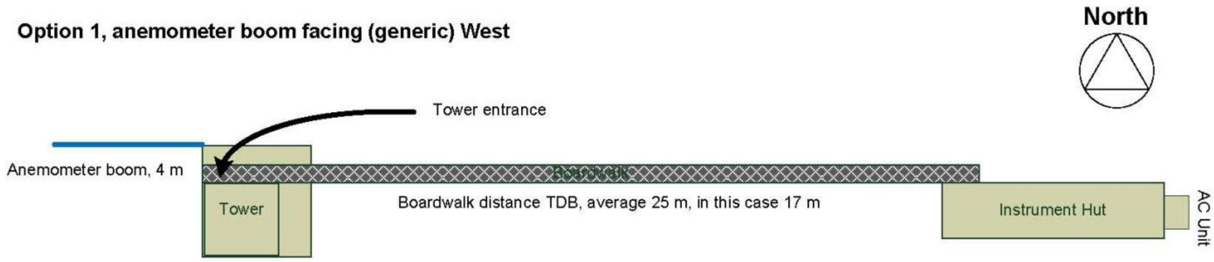


Figure 23 Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the east towards the tower.

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 SCBI Advanced site, the boom angle will be 300 degrees, instrument hut will be on the SE towards the tower, the distance between instrument hut and tower is ~15 m. The instrument hut vector will be NE-SW (30^o-210^o, longwise).

3.4.7 Information for ecosystem productivity plots

The tower at SCBI Advanced site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (tulip popular-oak-black walnut hardwood forest). Major airshed area at this site are from 0^o to 70^o (clockwise from 0^o) and 155^o to 230^o (clock wise from 155^o), and 90% signals for flux measurements are in a distance of 800 m from tower, and 80% within 600 m. We suggest FSU Ecosystem Productivity plots be placed within the boundaries of 0^o to 70^o (clockwise from 0^o) and 155^o to 230^o (clock wise from 155^o) from tower.

3.5 Issues and attentions

SCBI is very willing to collaborate with NEON. We are not aware of any major logistics or political issues. Tower site is on a hill slope. Cold air drainage is likely to happen, like any other non-flat site. Caution is needed when interpreting such flux data. DFIR location is about 1.2 km away from tower location, but in the same watershed.

4 SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER (SERC), RELOCATEABLE TOWER 1

4.1 Site description

NEON candidate Relocatable site is located inside the Smithsonian Environmental Research Center (SERC) property, Figure 24.

The Smithsonian Environmental Research Center (SERC) is a 2,800-acre (11 km2) environmental research and educational facility operated by the Smithsonian Institution located in Edgewater, MD on the Rhode and West Rivers. The center's focus of study is on the ecosystems of coastal zones, particularly in the Chesapeake Bay wetlands. The SERC conducts research on a wide variety of topics that include terrestrial, atmospheric, and estuarine environmental research within the disciplines of botany, ecology, environmental education, biology, chemistry, mathematics, microbiology, physics, and zoology. The Center trains interns, graduate students, pre-doctoral and doctoral students. Annually, the Center receives over 10,000 students, teachers, and families who come to visit. It also gives advice, consultation, and testimony to local, state, federal, and international governmental agencies, natural resource managers, policy makers, and conservation groups. Additionally, it serves as a center of research and education on human impacts in land-sea interactions of the coastal zone. Their laboratory focuses on being a model of human interaction with the environment. The Center receives $20,000,000 in current extramural grants and contracts funded from governmental agencies, foundations, and industry. The Center has been an innovator of unique biotelemetry to track behavior, habitat use, and movement of blue crabs, a marine predator and a valuable crustacean fishery in North America. They are the patent holder for the Spectral Radiometer, the national standard for monitoring solar radiation. The Center has also developed a model for testing estuarine water quality and watershed nutrient discharges (http://en.wikipedia.org/wiki/Smithsonian_Environmental_Research_Center).

Figure 24 SERC property boundary and NEON candidate tower location

4.2 Ecosystem

The vegetation and land cover information at SERC are presented below:

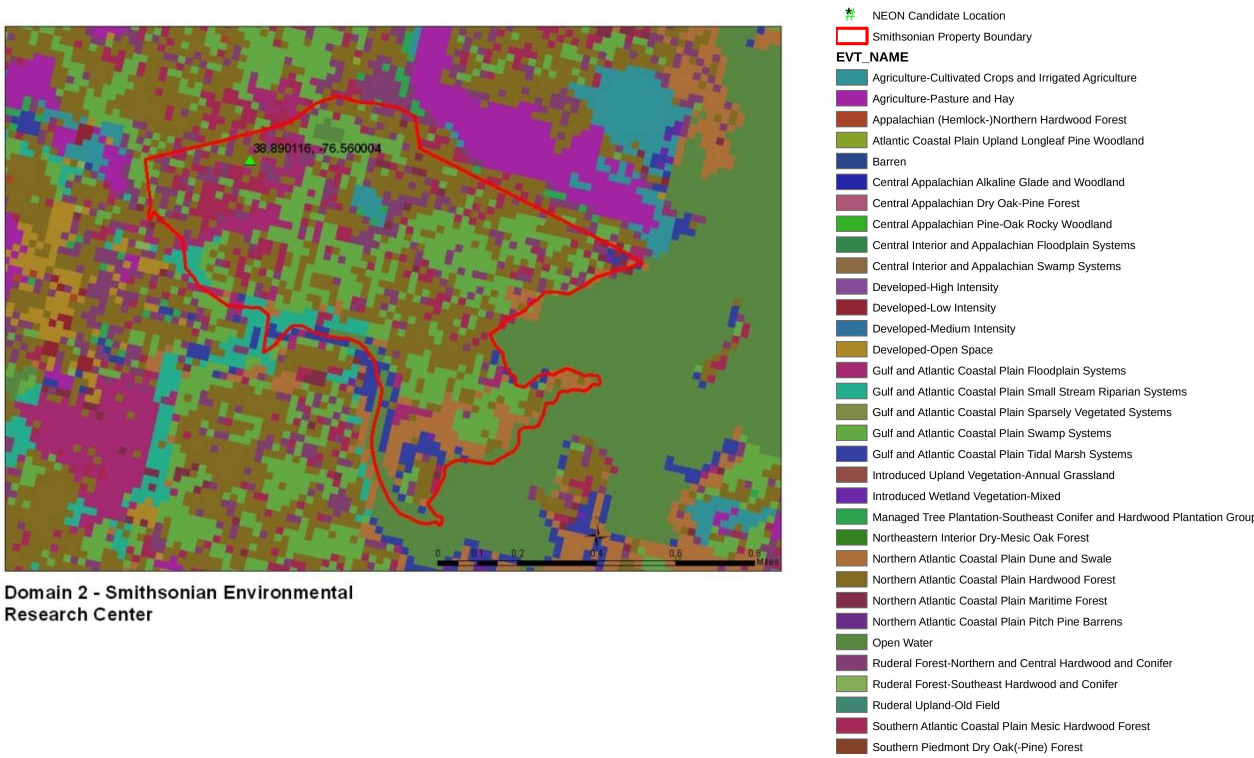


Figure 25. Vegetative cover map of SERC and surrounding areas
(information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm)

Table 8. Land cover information at SERC site
(information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm).

Vegetation Type	**Area (km^2)**	Percentage
Open Water	0.068807164	4.38381932
Agriculture-Cultivated Crops and Irrigated Agriculture	0.0135	0.86010755
Introduced Wetland Vegetation-Mixed	0.0018	0.11468101
Northern Atlantic Coastal Plain Hardwood Forest	0.462667538	29.4773216
Southern Atlantic Coastal Plain Mesic Hardwood Forest	0.132690552	8.45393672
Northern Atlantic Coastal Plain Maritime Forest	0.014692541	0.93608632
Northern Atlantic Coastal Plain Dune and Swale	0.098337323	6.26523509
Gulf and Atlantic Coastal Plain Floodplain Systems	0.077292212	4.92441591
Gulf and Atlantic Coastal Plain Small Stream Riparian Systems	0.039678943	2.52801172
Gulf and Atlantic Coastal Plain Swamp Systems	0.464885291	29.6186184
Gulf and Atlantic Coastal Plain Tidal Marsh Systems	0.046419674	2.95747496
Ruderal Forest-Northern and Central Hardwood and Conifer	0.146099921	9.30826999

Managed Tree Plantation-Southeast Conifer and Hardwood Plantation Group	0.0027	0.17202151
Total area sq km	1.569571159	100

The representative ecosystem at SERC is hardwood deciduous forest dominant by tulip popular, oak and ash. Selective logging occurs at the north end of the property. Majority forest in the property is well preserved for research use. Our interest is in the well preserved forest.

Canopy height is 38 m around tower site with lowest branches at 10 m above ground level. Oak recruitments form the upper understory, which vary from 3 to 15 m in height without obvious strata. Seedlings and sapling of ash and oak forms the lower understory with height 0.5-1.5 m. Ferns and new recruitment of ash and oak form the understory at ground level with height ~ 0.3 m (Figure 26). Grass and other annuals are not common at this site.

Figure 26 Ecosystem at SERC Relocatable site

Table 9. Ecosystem and site attributes for the SERC Relocatable site.

Ecosystem attributes	Measure and units
Mean canopy height	38 m
Surface roughness[a]	6 m
Zero place displacement height[a]	32 m
Structural elements	Closed-canopy, uniform, homogeneous
Time zone	Eastern time
Magnetic declination	11° 5' W changing by 0° 0' W/year

Note, [a] From field survey.

The other ecosystem info provided by Dr Geoffrey (Jess) Parker is presented below:

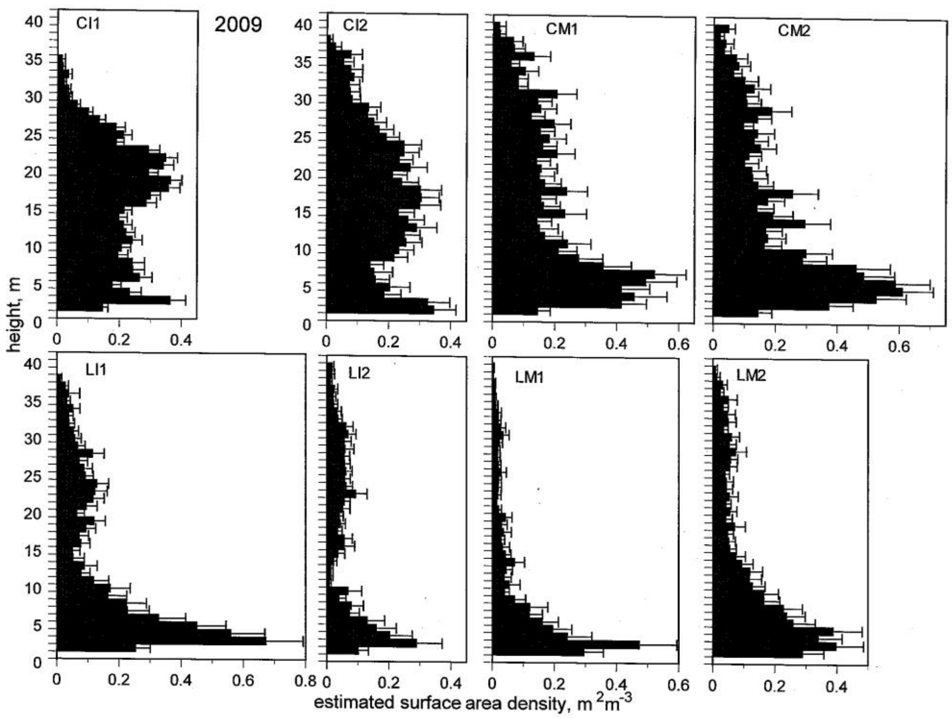


Figure 27 Variation of estimated surface area density with height for the ecosystem at SERC

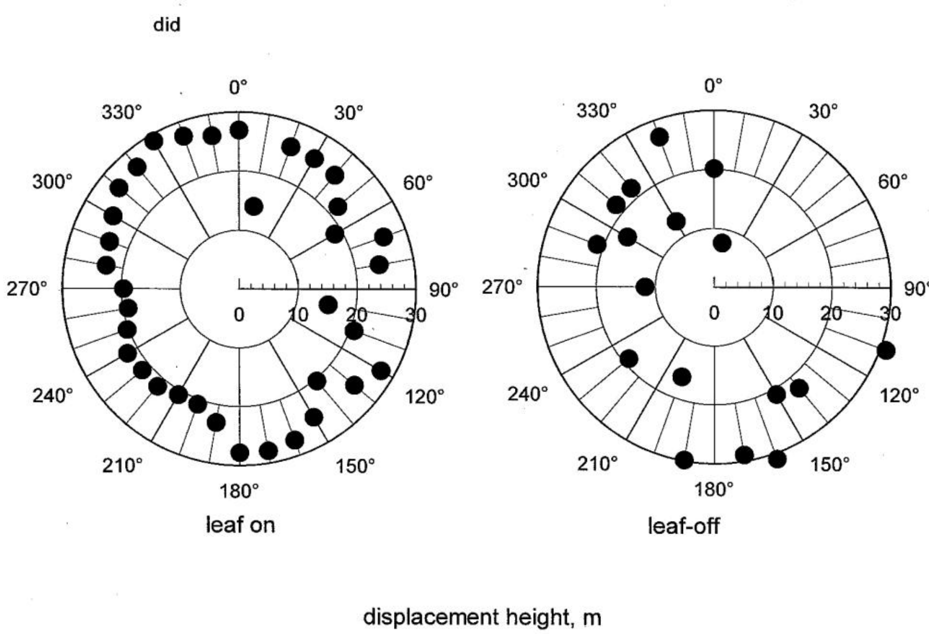


Figure 28 Ecosystem zero displacement height at SERC relocatable site

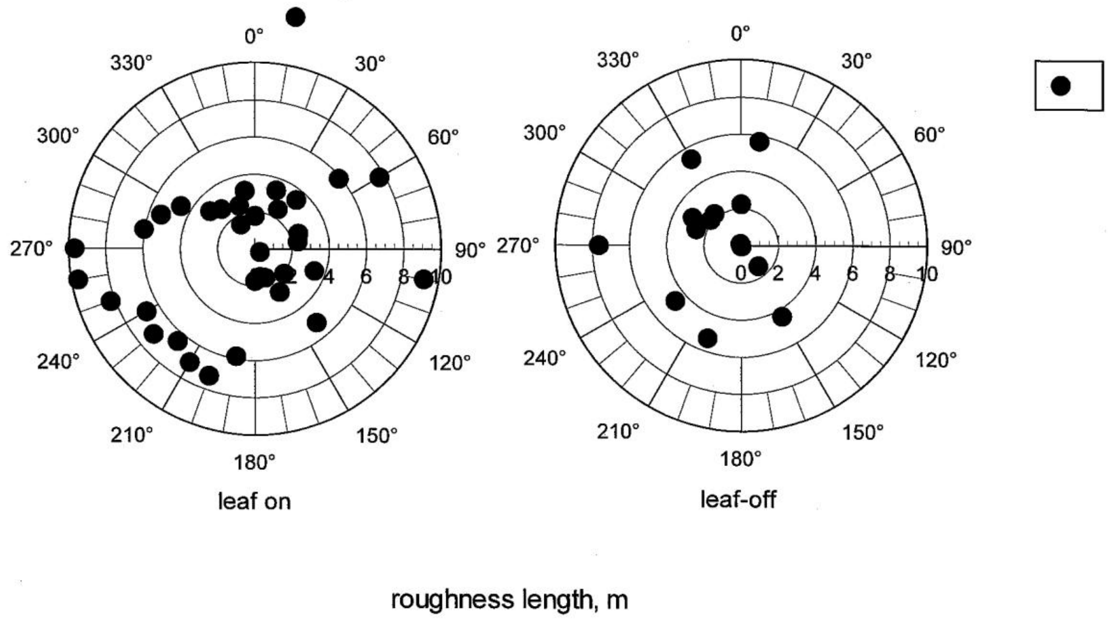


Figure 29 Ecosystem roughness length at SERC relocatable site

4.3 Soils

4.3.1 Description of soils

Soil data and soil maps (Figures 30) below for the SERC tower site were collected from 2.2 km^2 NRCS soil maps (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm), which centered at the tower location, 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 a co-dominant) soil type(s) present in the tower footprint.

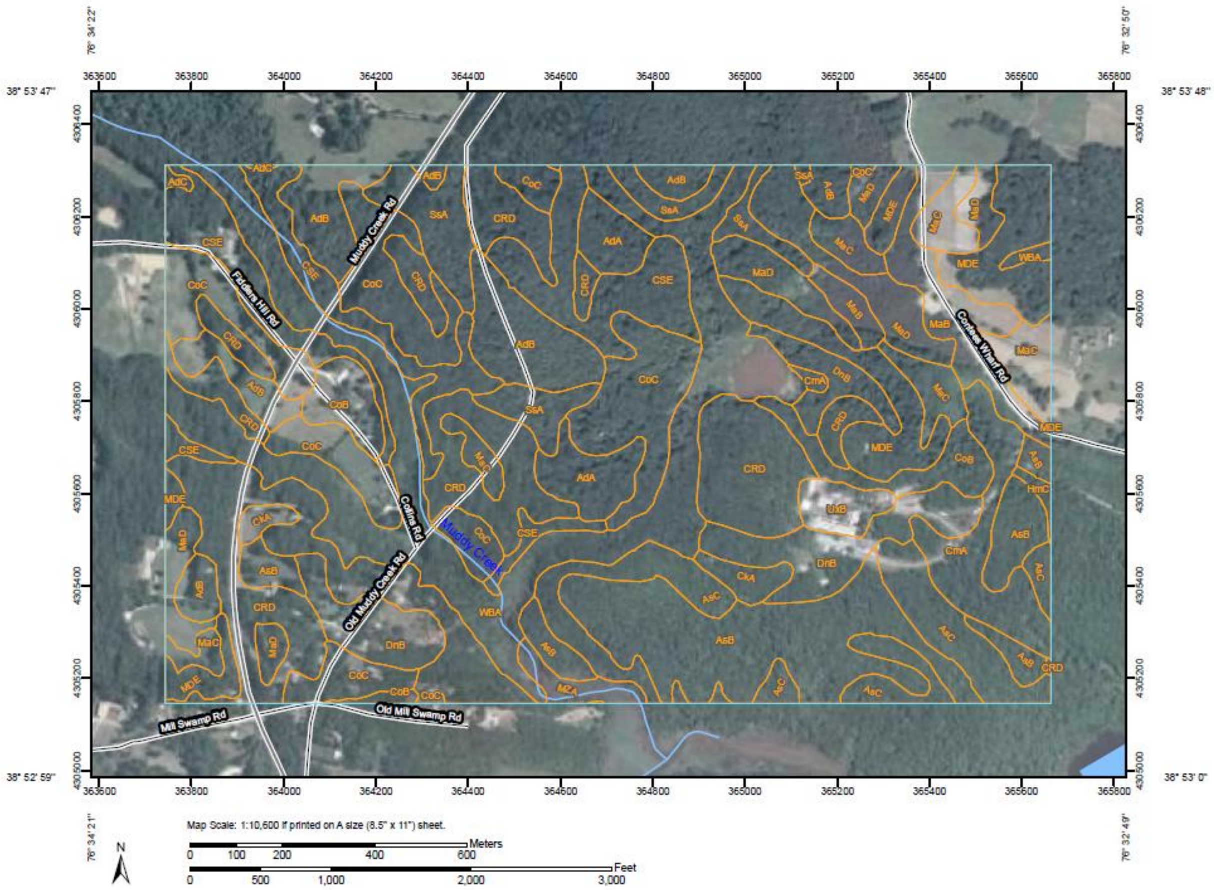


Figure 30. 2.2 km^2 soil map for the SERC relocatable site.

Map Unit Description The map units delineated on the detailed soil maps in a soil survey represent 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, 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 soil types 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, is 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 10. Soil series and percentage of soil series within 2.2 km^2 centered on the tower.

Anne Arundel County, Maryland (MD003)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AdA	Adelphia-Holmdel complex, 0 to 2 percent slopes	11.9	2.2%
AdB	Adelphia-Holmdel complex, 2 to 5 percent slopes	32.6	5.9%
AdC	Adelphia-Holmdel complex, 5 to 10 percent slopes	0.6	0.1%
AsB	Annapolis fine sandy loam, 2 to 5 percent slopes	50.8	9.2%
AsC	Annapolis fine sandy loam, 5 to 10 percent slopes	28.8	5.2%
CkA	Colemantown fine sandy loam, 0 to 2 percent slopes	4.7	0.8%
CmA	Colemantown silt loam, 0 to 2 percent slopes	14.9	2.7%
CoB	Collington-Wist complex, 2 to 5 percent slopes	14.1	2.6%
CoC	Collington-Wist complex, 5 to 10 percent slopes	54.0	9.8%
CRD	Collington and Annapolis soils, 10 to 15 percent slopes	79.8	14.4%
CSE	Collington, Wist, and Westphalia soils, 15 to 25 percent slopes	43.4	7.8%
DnB	Donlonton fine sandy loam, 2 to 5 percent slopes	29.1	5.3%
HmC	Howell-Annapolis complex, 5 to 10 percent slopes	0.9	0.2%
MaB	Marr-Dodon complex, 2 to 5 percent slopes	15.9	2.9%
MaC	Marr-Dodon complex, 5 to 10 percent slopes	20.4	3.7%
MaD	Marr-Dodon complex, 10 to 15 percent slopes	26.7	4.8%
MDE	Marr and Dodon soils, 15 to 25 percent slopes	31.2	5.6%
MZA	Mispillion and Transquaking soils, 0 to 1 percent slopes, tidally flooded	3.7	0.7%
SsA	Shrewsbury loam, 0 to 2 percent slopes	19.9	3.6%
UxB	Udorthents, loamy, sulfidic substratum, 0 to 5 percent slopes	4.7	0.8%
WBA	Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded	65.4	11.8%
Totals for Area of Interest		**553.6**	**100.0%**

Anne Arundel County, Maryland - AdA—Adelphia-Holmdel complex, 0 to 2 percent slopes: Map Unit Setting Elevation: 10 to 330 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Adelphia and similar soils: 60 percent Holmdel and similar soils: 25 percent Minor components: 15 percent **Description of Adelphia Setting** Landform: Swales, drainageways, depressions, drainhead complexes, interfluves Landform position (two-dimensional): Footslope Down-slope shape: Linear, concave Across-slope shape: Concave, linear Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 0 to 2 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 (0.20 to 1.98 in/hr) Depth to water table: About 20 to 40 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.4 inches) **Interpretive groups** Land capability (nonirrigated): 2w **Typical profile** 0 to 6 inches: Silt loam 6 to 19 inches: Loamy fine sand 19 to 22 inches: Fine sandy loam 22 to 47 inches: Loam 47 to 71 inches: Fine sandy loam 71 to 80 inches: Fine sandy loam **Description of Holmdel Setting** Landform: Swales, drainageways, depressions, drainhead complexes, interfluves Landform position (two-dimensional): Toeslope Down-slope shape: Linear, concave Across-slope shape: Concave Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 0 to 2 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 high to high (0.20 to 6.00 in/hr) Depth to water table: About 10 to 20 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.3 inches) **Interpretive groups** Land capability (nonirrigated): 3w **Typical profile** 0 to 8 inches: Fine sandy loam 8 to 54 inches: Sandy clay loam 54 to 72 inches: Fine sandy loam **Minor Components Wist** Percent of map unit: 10 percent Landform: Interfluves Down-slope shape: Linear Across-slope shape: Linear Shrewsbury Percent of map unit: 5 percent Landform: Depressions, drainageways, swales Down-slope shape: Concave, linear Across-slope shape: Concave, linear

Anne Arundel County, Maryland - AdB—Adelphia-Holmdel complex, 2 to 5 percent slopes: Map Unit Setting Elevation: 10 to 330 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Adelphia and similar soils: 55 percent Holmdel and similar soils: 25 percent Minor components: 20 percent **Description of Adelphia Setting** Landform: Swales, drainageways, depressions, drainhead complexes, interfluves Landform position (two-dimensional): Footslope Down-slope shape: Concave Across-slope shape: Linear, concave Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 2 to 5 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 (0.20 to 1.98 in/hr) Depth to water table: About 20 to 40 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.4 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 6 inches: Silt loam 6 to 19 inches: Loamy fine sand 19 to 22 inches: Fine sandy loam 22 to 47 inches: Loam 47 to 71 inches: Fine sandy loam 71 to 80 inches: Fine sandy loam **Description of Holmdel Setting** Landform: Swales, drainageways, depressions, drainhead complexes, interfluves Landform position (two-dimensional): Toeslope Down-slope shape: Linear, concave Across-slope shape: Concave Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 2 to 5 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 high to high (0.20 to 6.00 in/hr) Depth to water table: About 10 to 20 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.3 inches) **Interpretive groups** Land capability (nonirrigated): 3w **Typical profile** 0 to 8 inches: Fine sandy loam 8 to 54 inches: Sandy clay loam 54 to 72 inches: Fine sandy loam **Minor Components Wist** Percent of map unit: 15 percent Landform: Interfluves Down-slope shape: Linear Across-slope shape: Linear Shrewsbury Percent of map unit: 5 percent Landform: Depressions, drainageways, fluviomarine terraces, swales Landform position (three-dimensional): Tread Down-slope shape: Concave, linear Across-slope shape: Concave

Anne Arundel County, Maryland - AdC—Adelphia-Holmdel complex, 5 to 10 percent slopes: Map Unit Setting Elevation: 10 to 330 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Adelphia and similar soils: 55 percent Holmdel and similar soils: 25 percent Minor components: 20 percent **Description of Adelphia Setting** Landform: Swales, drainageways, depressions, drainhead complexes, interfluves Landform position (two-dimensional): Footslope Down-slope shape: Concave, linear Across-slope shape: Linear, concave Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 (0.20 to 1.98 in/hr) Depth to water table: About 20 to 40 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.4 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 6 inches: Silt loam 6 to 19 inches: Loamy fine sand 19 to 22 inches: Fine sandy loam 22 to 47 inches: Loam 47 to 71 inches: Fine sandy loam 71 to 80 inches: Fine sandy loam **Description of Holmdel Setting** Landform: Swales, drainageways, depressions, drainhead complexes, interfluves Landform position (two-dimensional): Toeslope Down-slope shape: Concave, linear Across-slope shape: Linear, concave Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 high to high (0.20 to 6.00 in/hr) Depth to water table: About 10 to 20 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.3 inches) **Interpretive groups** Land capability (nonirrigated): 3w **Typical profile** 0 to 8 inches: Fine sandy loam 8 to 54 inches: Sandy clay loam 54 to 72 inches: Fine sandy loam **Minor Components Wist** Percent of map unit: 15 percent Landform: Interfluves Down-slope shape: Linear Across-slope shape: Linear Shrewsbury Percent of map unit: 5 percent Landform: Depressions, drainageways, swales Down-slope shape: Concave Across-slope shape: Concave, linear

Anne Arundel County, Maryland - AsB—Annapolis fine sandy loam, 2 to 5 percent slopes: Map Unit Setting Elevation: 10 to 160 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Annapolis and similar soils: 80 percent Minor components: 20 percent **Description of Annapolis Setting** Landform: Broad interstream divides Down-slope shape: Linear Across-slope shape: Linear Parent material: Glauconitic loamy fluviomarine deposits **Properties and qualities** Slope: 2 to 5 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 high (0.14 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.0 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 8 inches: Fine sandy loam 8 to 27 inches: Channery sandy clay loam 27 to 61 inches: Loamy sand 61 to 81 inches: Loamy sand **Minor Components Collington** Percent of map unit: 10 percent Landform: Broad interstream divides Down-slope shape: Linear Across-slope shape: Linear Donlonton Percent of map unit: 10 percent Landform: Swales, depressions Down-slope shape: Concave Across-slope shape: Linear, concave

Anne Arundel County, Maryland - AsC—Annapolis fine sandy loam, 5 to 10 percent slopes: Map Unit Setting Elevation: 10 to 160 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Annapolis and similar soils: 80 percent Minor components: 20 percent **Description of Annapolis Setting** Landform: Broad interstream divides Landform position (two-dimensional): Shoulder Down-slope shape: Linear Across-slope shape: Linear Parent material: Glauconitic loamy fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 high (0.14 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.0 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 8 inches: Fine sandy loam 8 to 27 inches: Channery sandy clay loam 27 to 61 inches: Loamy sand 61 to 81 inches: Loamy sand **Minor Components Collington** Percent of map unit: 10 percent Landform: Broad interstream divides Down-slope shape: Linear Across-slope shape: Linear Donlonton Percent of map unit: 10 percent Landform: Swales, depressions Down-slope shape: Concave Across-slope shape: Linear, concave

Anne Arundel County, Maryland - CkA—Colemantown fine sandy loam, 0 to 2 percent slopes: Map Unit Setting Elevation: 10 to 330 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Colemantown and similar soils: 80 percent Minor components: 20 percent **Description of Colemantown Setting** Landform: Depressions, drainageways, swales Down-slope shape: Concave, linear Across-slope shape: Concave Parent material: Glauconitic clayey fluviomarine deposits **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Poorly drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr) Depth to water table: About 0 to 10 inches Frequency of flooding: None Frequency of ponding: Occasional Available water capacity: Moderate (about 8.2 inches) **Interpretive groups** Land capability (nonirrigated): 5w **Typical profile** 0 to 10 inches: Fine sandy loam 10 to 13 inches: Loamy fine sand 13 to 42 inches: Sandy clay 42 to 48 inches: Sandy clay 48 to 80 inches: Sandy clay loam **Minor Components Shrewsbury** Percent of map unit: 10 percent Landform: Depressions, drainageways, swales **Keansburg** Percent of map unit: 5 percent Landform: Depressions **Donlonton** Percent of map unit: 5 percent Landform: Interfluves

Anne Arundel County, Maryland - CmA—Colemantown silt loam, 0 to 2 percent slopes: Map Unit Setting Elevation: 10 to 330 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Colemantown and similar soils: 80 percent Minor components: 20 percent **Description of Colemantown Setting** Landform: Depressions, drainageways, swales Down-slope shape: Concave, linear Across-slope shape: Concave Parent material: Glauconitic clayey fluviomarine deposits **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Poorly drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr) Depth to water table: About 0 to 10 inches Frequency of flooding: None Frequency of ponding: Occasional Available water capacity: Moderate (about 8.6 inches) **Interpretive groups** Land capability (nonirrigated): 5w **Typical profile** 0 to 10 inches: Silt loam 10 to 13 inches: Loamy fine sand 13 to 42 inches: Sandy clay 42 to 48 inches: Sandy clay 48 to 80 inches: Sandy clay loam **Minor Components Shrewsbury** Percent of map unit: 10 percent Landform: Depressions, drainageways, swales Down-slope shape: Concave Across-slope shape: Linear **Keansburg** Percent of map unit: 5 percent Landform: Depressions Down-slope shape: Concave Across-slope shape: Concave **Donlonton** Percent of map unit: 5 percent Landform: Interfluves Down-slope shape: Linear Across-slope shape: Linear

Anne Arundel County, Maryland - CSE—Collington, Wist, and Westphalia soils, 15 to 25 percent slopes: Map Unit Setting Elevation: 10 to 230 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Collington and similar soils: 35 percent Wist and similar soils: 30 percent Westphalia and similar soils: 20 percent Minor components: 15 percent **Description of Collington Setting** Landform: Interfluves, hillslopes, knolls Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope, head slope, nose slope Down-slope shape: Linear Across-slope shape: Linear

Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 15 to 25 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 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 10.6 inches) **Interpretive groups** Land capability (nonirrigated): 6e **Typical profile** 0 to 4 inches: Fine sandy loam 4 to 34 inches: Sandy clay loam 34 to 72 inches: Fine sandy loam **Description of Wist Setting** Landform: Interfluves, knolls, hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 15 to 25 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 5.95 in/hr) Depth to water table: About 40 to 72 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 8.7 inches) **Interpretive groups** Land capability (nonirrigated): 6e **Typical profile** 0 to 3 inches: Fine sandy loam 3 to 13 inches: Fine sandy loam 13 to 41 inches: Sandy clay loam 41 to 82 inches: Fine sandy loam **Description of Westphalia Setting** Landform: Interfluves, knolls, hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy fluviomarine deposits **Properties and qualities** Slope: 15 to 25 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 6.3 inches) **Interpretive groups** Land capability (nonirrigated): 7e **Typical profile** 0 to 6 inches: Fine sandy loam 6 to 12 inches: Fine sandy loam 12 to 42 inches: Loamy fine sand 42 to 72 inches: Loamy fine sand **Minor Components Adelphia** Percent of map unit: 10 percent Landform: Hillslopes, drainhead complexes, depressions, interfluves Landform position (two-dimensional): Toeslope, footslope **Widewater** Percent of map unit: 5 percent Landform: Flood plains, drainageways, drainhead complexes

Anne Arundel County, Maryland - CRD—Collington and Annapolis soils, 10 to 15 percent slopes: Map Unit Setting Elevation: 10 to 230 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Collington and similar soils: 45 percent Annapolis and similar soils: 30 percent Minor components: 25 percent **Description of Collington Setting** Landform: Interfluves, knolls, hillslopes Landform position (two-dimensional): Backslope Down-slope shape: Linear Across-slope shape: Convex Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 10 to 15 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 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 10.5 inches) **Interpretive groups** Land capability (nonirrigated): 4e **Typical profile** 0 to 10 inches: Fine sandy loam 10 to 34 inches: Sandy clay loam 34 to 72 inches: Fine sandy loam **Description of Annapolis Setting** Landform: Interfluves, knolls, hillslopes Landform position (two-dimensional): Backslope Down-slope shape: Linear Across-slope shape: Convex Parent material: Glauconitic loamy fluviomarine deposits **Properties and qualities** Slope: 10 to 15 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 high (0.14 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.0 inches) **Interpretive groups** Land capability (nonirrigated): 4e **Typical profile** 0 to 8 inches: Fine sandy loam 8 to

27 inches: Channery sandy clay loam 27 to 61 inches: Loamy sand 61 to 81 inches: Loamy sand **Minor Components Wist** Percent of map unit: 10 percent Landform: Knolls, hillslopes **Westphalia** Percent of map unit: 10 percent Landform: Knolls, hillslopes **Holmdel** Percent of map unit: 5 percent Landform: Drainhead complexes, swales, depressions, interfluves Landform position (two-dimensional): Toeslope

Anne Arundel County, Maryland - CoB—Collington-Wist complex, 2 to 5 percent slopes: Map Unit Setting Elevation: 10 to 230 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Collington and similar soils: 50 percent Wist and similar soils: 35 percent Minor components: 15 percent **Description of Collington Setting** Landform: Broad interstream divides, interfluves Landform position (two-dimensional): Summit Landform position (three-dimensional): Interfluve Down-slope shape: Linear Across-slope shape: Linear Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 2 to 5 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 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 10.5 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 10 inches: Fine sandy loam 10 to 34 inches: Sandy clay loam 34 to 72 inches: Fine sandy loam **Description of Wist Setting** Landform: Broad interstream divides, interfluves Landform position (two-dimensional): Backslope, shoulder, summit Landform position (three-dimensional): Interfluve Down-slope shape: Linear Across-slope shape: Linear Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 2 to 5 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 5.95 in/hr) Depth to water table: About 40 to 72 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 9.0 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 13 inches: Fine sandy loam 13 to 17 inches: Fine sandy loam 17 to 41 inches: Sandy clay loam 41 to 82 inches: Fine sandy loam **Minor Components Adelphia** Percent of map unit: 15 percent Landform: Swales, depressions, drainhead complexes Down-slope shape: Linear, concave Across-slope shape: Concave

Anne Arundel County, Maryland - CoC—Collington-Wist complex, 5 to 10 percent slopes: Map Unit Setting Elevation: 10 to 230 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Collington and similar soils: 45 percent Wist and similar soils: 35 percent Minor components: 20 percent **Description of Collington Setting** Landform: Broad interstream divides, interfluves Landform position (two-dimensional): Summit Landform position (three-dimensional): Interfluve Down-slope shape: Linear Across-slope shape: Linear Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 10.5 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 10 inches: Fine sandy loam 10 to 34 inches: Sandy clay loam 34 to 72 inches: Fine sandy loam **Description of Wist Setting** Landform: Broad interstream divides, interfluves Landform position (two-dimensional): Backslope, shoulder, summit Landform position (three-dimensional): Interfluve Down-slope shape: Linear Across-slope shape: Linear Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 5.95 in/hr) Depth to water table: About 40 to 72 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 9.0 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 13 inches: Fine sandy loam 13 to 17 inches: Fine sandy loam 17 to 41 inches: Sandy clay loam 41 to 82 inches: Fine sandy loam **Minor Components Adelphia** Percent of map unit: 15 percent Landform: Depressions, drainhead complexes, swales Down-slope shape: Concave Across-slope shape: Concave, linear **Tinton** Percent of map unit: 5 percent Landform: Interfluves Down-slope shape: Linear Across-slope shape: Linear

Anne Arundel County, Maryland - DnB—Donlonton fine sandy loam, 2 to 5 percent slopes: Map Unit Setting Elevation: 0 to 230 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Donlonton and similar soils: 80 percent Minor components: 20 percent **Description of Donlonton Setting** Landform: Drainageways, swales, drainhead complexes Landform position (two-dimensional): Footslope Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Concave, linear Parent material: Glauconitic loamy fluviomarine deposits **Properties and qualities** Slope: 2 to 5 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 20 to 40 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 10.9 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 9 inches: Fine sandy loam 9 to 27 inches: Sandy clay loam 27 to 46 inches: Loam 46 to 75 inches: Silty clay loam **Minor Components Tinton** Percent of map unit: 5 percent Landform: Interfluves Landform position (two-dimensional): Toeslope **Colemantown** Percent of map unit: 5 percent Landform: Depressions, drainageways

Anne Arundel County, Maryland - HmC—Howell-Annapolis complex, 5 to 10 percent slopes: Map Unit Setting Elevation: 10 to 200 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Howell and similar soils: 50 percent Annapolis and similar soils: 40 percent Minor components: 10 percent **Description of Howell Setting** Landform: Knolls, interfluves Landform position (two-dimensional): Backslope Down-slope shape: Linear Across-slope shape: Convex Parent material: Clayey fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 high (0.06 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.2 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 5 inches: Clay loam 5 to 17 inches: Clay 17 to 80 inches: Silty clay **Description of Annapolis Setting** Landform: Knolls, interfluves Landform position (two-dimensional): Backslope Down-slope shape: Linear Across-slope shape: Convex Parent material: Glauconitic loamy fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 high (0.14 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.0 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 8 inches: Fine sandy loam 8 to 27 inches: Channery sandy clay loam 27 to 61 inches: Loamy sand 61 to 81 inches: Loamy sand **Minor Components Wist** Percent of map unit: 5 percent Landform: Swales, knolls, interfluves Landform position (two-dimensional): Backslope **Marr** Percent of map unit: 5 percent Landform: Interfluves, knolls Landform position (two-dimensional): Shoulder

Anne Arundel County, Maryland - MDE—Marr and Dodon soils, 15 to 25 percent slopes: Map Unit Setting Elevation: 10 to 200 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Marr and similar soils: 45 percent Dodon and similar soils: 40 percent Minor components: 15 percent **Description of Marr Setting** Landform: Interfluves, knolls, fluviomarine terraces Landform position (two-dimensional): Backslope Landform position (three-dimensional): Riser Down-slope shape: Linear, convex Across-slope shape: Linear, convex Parent material: Loamy fluviomarine deposits **Properties and qualities** Slope: 15 to 25 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 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.2 inches) **Interpretive groups** Land capability (nonirrigated): 6e **Typical profile** 0 to 3 inches: Fine sandy loam 3 to 25 inches: Fine sandy loam 25 to 57 inches: Sandy clay loam 57 to 76 inches: Loamy fine sand **Description of Dodon Setting** Landform: Interfluves, knolls, fluviomarine terraces Landform position (two-dimensional): Backslope Landform position (three-dimensional): Riser Down-slope shape: Linear, convex Across-slope shape: Linear, convex Parent material: Loamy fluviomarine deposits **Properties and qualities** Slope: 15 to 25 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 (0.20 to 2.00 in/hr) Depth to water table: About 20 to 40 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 10.3 inches) **Interpretive groups** Land capability (nonirrigated): 6e **Typical profile** 0 to 5 inches: Very fine sandy loam 5 to 16 inches: Very fine sandy loam 16 to 47 inches: Loam 47 to 73 inches: Loam **Minor Components Piccowaxen** Percent of map unit: 10 percent Landform: Drainhead complexes, interfluves Landform position (two-dimensional): Backslope, shoulder **Howell** Percent of map unit: 5 percent Landform: Interfluves Landform position (two-dimensional): Backslope

Anne Arundel County, Maryland - MaB—Marr-Dodon complex, 2 to 5 percent slopes: Map Unit Setting Elevation: 10 to 200 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Marr and similar soils: 45 percent Dodon and similar soils: 35 percent Minor components: 20 percent **Description of Marr Setting** Landform: Knolls, interfluves Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy fluviomarine deposits **Properties and qualities** Slope: 2 to 5 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 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None vailable water capacity: High (about 9.5 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 12 inches: Fine sandy loam 12 to 25 inches: Fine sandy loam 25 to 57 inches: Sandy clay loam 57 to 76 inches: Loamy fine sand **Description of Dodon Setting** Landform: Stream terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy fluviomarine deposits **Properties and qualities** Slope: 2 to 5 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 20 to 40 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.8 inches) **Interpretive groups** Land capability (nonirrigated): 2e

Typical profile 0 to 9 inches: Fine sandy loam 9 to 36 inches: Sandy clay loam 36 to 48 inches: Sandy clay loam 48 to 64 inches: Fine sandy loam **Minor Components Hambrook** Percent of map unit: 10 percent Landform: Interfluves, knolls Landform position (two-dimensional): Summit Down-slope shape: Linear, convex Across-slope shape: Linear, convex **Fine-loamy aquic paleudults** Percent of map unit: 10 percent Landform: Interfluves, knolls Landform position (two-dimensional): Summit Down-slope shape: Linear, convex Across-slope shape: Linear, convex

Anne Arundel County, Maryland - MaC—Marr-Dodon complex, 5 to 10 percent slopes: Map Unit Setting Elevation: 10 to 200 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Marr and similar soils: 50 percent Dodon and similar soils: 35 percent Minor components: 15 percent **Description of Marr Setting** Landform: Knolls, interfluves Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.5 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 12 inches: Fine sandy loam 12 to 25 inches: Fine sandy loam 25 to 57 inches: Sandy clay loam 57 to 76 inches: Loamy fine sand **Description of Dodon Setting** Landform: Stream terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy fluviomarine deposits **Properties and qualities** Slope: 5 to 10 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 20 to 40 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.8 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 9 inches: Fine sandy loam 9 to 36 inches: Sandy clay loam 36 to 48 inches: Sandy clay loam 48 to 64 inches: Fine sandy loam **Minor Components Piccowaxen** Percent of map unit: 10 percent Landform: Drainhead complexes, interfluves Landform position (two-dimensional): Shoulder, backslope Down-slope shape: Linear Across-slope shape: Linear **Howell** Percent of map unit: 5 percent Landform: Interfluves, knolls Landform position (two-dimensional): Backslope Down-slope shape: Linear, convex Across-slope shape: Linear, convex

Anne Arundel County, Maryland - MaD—Marr-Dodon complex, 10 to 15 percent slopes: Map Unit Setting Elevation: 10 to 200 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Marr and similar soils: 45 percent Dodon and similar soils: 40 percent Minor components: 15 percent **Description of Marr Setting** Landform: Knolls, interfluves Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy fluviomarine deposits **Properties and qualities** Slope: 10 to 15 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 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.5 inches) **Interpretive groups** Land capability (nonirrigated): 4e **Typical profile** 0 to 12 inches: Fine sandy loam 12 to 25 inches: Fine sandy loam 25 to 57 inches: Sandy clay loam 57 to 76 inches: Loamy fine sand **Description of Dodon Setting** Landform: Interfluves, knolls Landform position (two-dimensional): Backslope Down-slope shape: Linear, convex Across-slope shape: Linear, convex Parent material: Loamy fluviomarine deposits **Properties and**

qualities Slope: 10 to 15 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 (0.20 to 2.00 in/hr) Depth to water table: About 20 to 40 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 10.3 inches) **Interpretive groups** Land capability (nonirrigated): 4e **Typical profile** 0 to 5 inches: Very fine sandy loam 5 to 16 inches: Very fine sandy loam 16 to 47 inches: Loam 47 to 73 inches: Loam **Minor Components Piccowaxen** Percent of map unit: 10 percent Landform: Drainhead complexes, interfluves Landform position (two-dimensional): Backslope, shoulder Down-slope shape: Linear Across-slope shape: Linear **Howell** Percent of map unit: 5 percent Landform: Interfluves, knolls Landform position (two-dimensional): Backslope

Anne Arundel County, Maryland - MZA—Mispillion and Transquaking soils, 0 to 1 percent slopes, tidally flooded: Map Unit Setting Elevation: 0 to 10 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Mispillion and similar soils: 45 percent Transquaking and similar soils: 40 percent Minor components: 15 percent **Description of Mispillion Setting** Landform: Tidal marshes Parent material: Herbaceous organic material over silty estuarine deposits **Properties and qualities** Slope: 0 to 1 percent Depth to restrictive feature: More than 80 inches Drainage class: Very poorly drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr) Depth to water table: About 0 to 10 inches Frequency of flooding: Very frequent Frequency of ponding: None Maximum salinity: Moderately saline to strongly saline (15.0 to 50.0 mmhos/cm) Sodium adsorption ratio, maximum: 35.0 Available water capacity: Very high (about 18.2 inches) **Interpretive groups** Land capability (nonirrigated): 8 **Typical profile** 0 to 15 inches: Mucky peat 15 to 37 inches: Muck 37 to 53 inches: Sandy loam 53 to 68 inches: Mucky loam 68 to 80 inches: Muck **Description of Transquaking Setting** Landform: Tidal marshes Parent material: Herbaceous organic material over estuarine deposits **Properties and qualities** Slope: 0 to 1 percent Depth to restrictive feature: More than 80 inches Drainage class: Very poorly drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 5.95 in/hr) Depth to water table: About 0 to 10 inches Frequency of flooding: Very frequent Frequency of ponding: None Maximum salinity: Strongly saline (25.0 to 40.0 mmhos/cm) Sodium adsorption ratio, maximum: 32.0 Available water capacity: Very high (about 26.2 inches) **Interpretive groups** Land capability (nonirrigated): 8 **Typical profile** 0 to 46 inches: Mucky peat 46 to 65 inches: Muck 65 to 80 inches: Silty clay loam **Minor Components Hydraquents** Percent of map unit: 15 percent Landform: Tidal marshes

Anne Arundel County, Maryland - SsA—Shrewsbury loam, 0 to 2 percent slopes: Map Unit Setting Elevation: 10 to 330 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Shrewsbury and similar soils: 75 percent Minor components: 25 percent **Description of Shrewsbury Setting** Landform: Depressions, drainageways, fluviomarine terraces, swales, drainhead complexes Landform position (three-dimensional): Tread Down-slope shape: Concave, linear Across-slope shape: Concave Parent material: Glauconite bearing loamy fluviomarine deposits **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Poorly drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr) Depth to water table: About 0 to 10 inches Frequency of flooding: None Frequency of ponding: Occasional Available water capacity: High (about 9.9 inches) **Interpretive groups** Land capability (nonirrigated): 4w **Typical profile** 0 to 7 inches: Loam 7 to 9 inches: Loam 9 to 28 inches: Sandy clay loam 28 to 82 inches: Sandy clay loam **Minor Components Holmdel** Percent of map unit: 15 percent Landform: Depressions, drainageways, drainhead complexes, swales Down-slope shape: Concave, linear Across-slope shape: Concave **Keansburg** Percent of map unit: 5 percent Landform: Drainageways, swales, depressions, drainhead complexes Down-slope shape: Linear, concave Across-slope shape: Concave **Fallsington** Percent of map unit: 5 percent Landform: Depressions, drainageways, drainhead complexes, swales Down-slope shape: Concave, linear Across-slope shape: Concave

Anne Arundel County, Maryland - UxB—Udorthents, loamy, sulfidic substratum, 0 to 5 percent slopes: Map Unit Setting Elevation: 30 to 660 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Udorthents and similar soils: 75 percent Minor components: 25 percent **Description of Udorthents Setting** Landform: Interfluves Landform position (two-dimensional): Toeslope Down-slope shape: Linear Across-slope shape: Linear **Properties and qualities** Slope: 0 to 5 percent Depth to restrictive feature: 18 to 80 inches to sulfuric Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr) Depth to water table: About 40 to 72 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 8.2 inches) **Interpretive groups** Land capability (nonirrigated): 4s **Typical profile** 0 to 2 inches: Sandy loam 2 to 72 inches: Loam **Minor Components Collington** Percent of map unit: 10 percent Landform: Broad interstream divides, interfluves Landform position (two-dimensional): Summit Down-slope shape: Linear Across-slope shape: Linear **Wist** Percent of map unit: 5 percent Landform: Broad interstream divides, interfluves Landform position (two-dimensional): Summit Down-slope shape: Linear Across-slope shape: Linear **Annapolis** Percent of map unit: 5 percent Landform: Broad interstream divides, interfluves Landform position (two-dimensional): Summit Down-slope shape: Linear Across-slope shape: Linear **Adelphia** Percent of map unit: 5 percent Landform: Depressions, drainageways, drainhead complexes, interfluves, swales Landform position (two-dimensional): Footslope Down-slope shape: Concave, linear Across-slope shape: Concave

Anne Arundel County, Maryland - WBA—Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded: Map Unit Setting Elevation: 0 to 600 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 57 degrees F Frost-free period: 180 to 210 days **Map Unit Composition** Widewater and similar soils: 40 percent Issue and similar soils: 40 percent Minor components: 20 percent **Description of Issue Setting** Landform: Flood plains, drainhead complexes, drainageways Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy alluvium **Properties and qualities** Slope: 0 to 2 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 high to high (0.60 to 2.00 in/hr) Depth to water table: About 10 to 20 inches Frequency of flooding: Occasional Frequency of ponding: None Available water capacity: High (about 9.9 inches) **Interpretive groups** Land capability (nonirrigated): 4w **Typical profile** 0 to 4 inches: Silt loam 4 to 19 inches: Loam 19 to 30 inches: Fine sandy loam 30 to 58 inches: Fine sandy loam 58 to 70 inches: Silt loam **Description of Widewater Setting** Landform: Flood plains, drainageways Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy alluvium **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: 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 0 to 10 inches Frequency of flooding: Frequent Frequency of ponding: Frequent Available water capacity: High (about 10.9 inches) **Interpretive groups** Land capability (nonirrigated): 5w **Typical profile** 0 to 4 inches: Loam 4 to 8 inches: Fine sandy loam 8 to 44 inches: Loam 44 to 67 inches: Loam 67 to 70 inches: Clay **Minor Components Zekiah** Percent of map unit: 10 percent Landform: Flood plains, drainageways **Longmarsh** Percent of map unit: 5 percent Landform: Channels on flood plains, backswamps on flood plains **Shrewsbury** Percent of map unit: 5 percent Landform: Drainageways, drainhead complexes, swales Landform position (three-dimensional): Tread

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 31). 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 31).

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 31), 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.

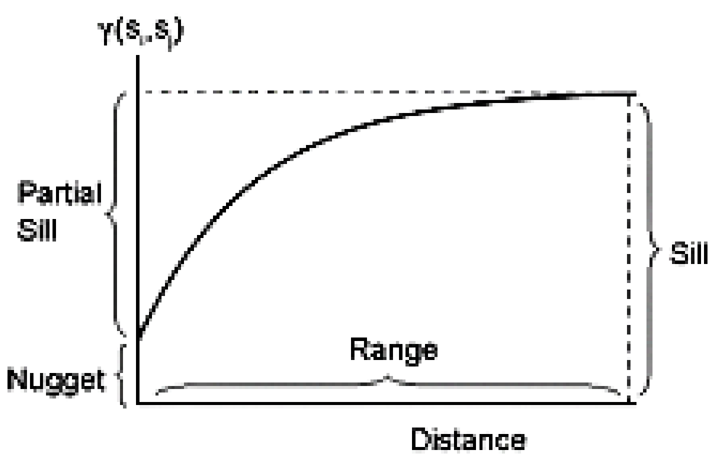


Figure 31. Example semivariogram, depicting range, sill, and nugget.

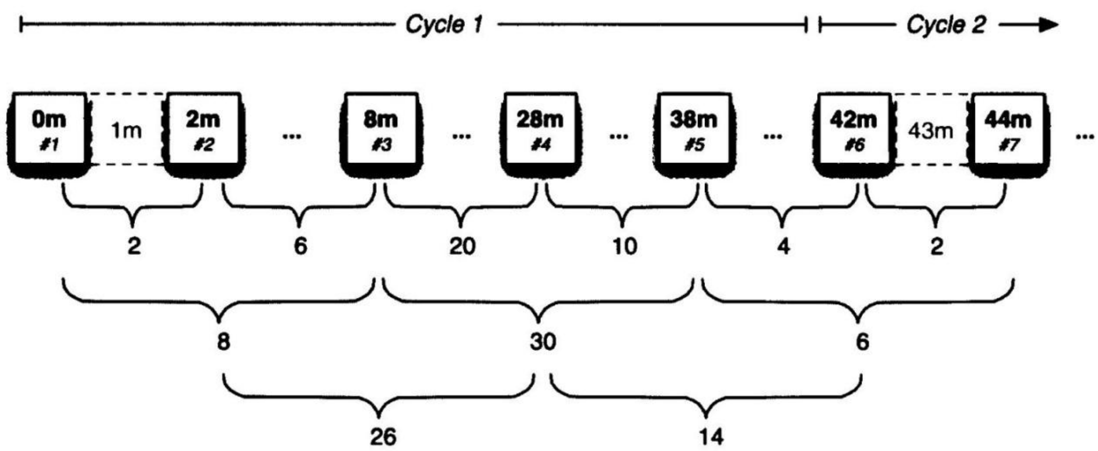


Figure 32. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 17 August 2010 at the SERC site. The sampling points followed the spatially cyclic sampling design by Bond-Lamberty et al. (2006) (Figure 32). Soil temperature and moisture measurements were collected along three transects (168 m, 78 m, and 80 m) located in the expected airshed at SERC. 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 32, 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).

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 and any remaining time of day trend, were used for the semivariogram analysis (Figure 33). Exploratory data analysis plots show that there was little patterning of the residuals, although the lowest temperatures tended to be at the centre of the transects (Figure 34, left graphs) and directional semivariograms do not show anisotropy (Figure 34, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 34, right graph). The model indicates a distance of effective independence of 34 m for soil temperature.

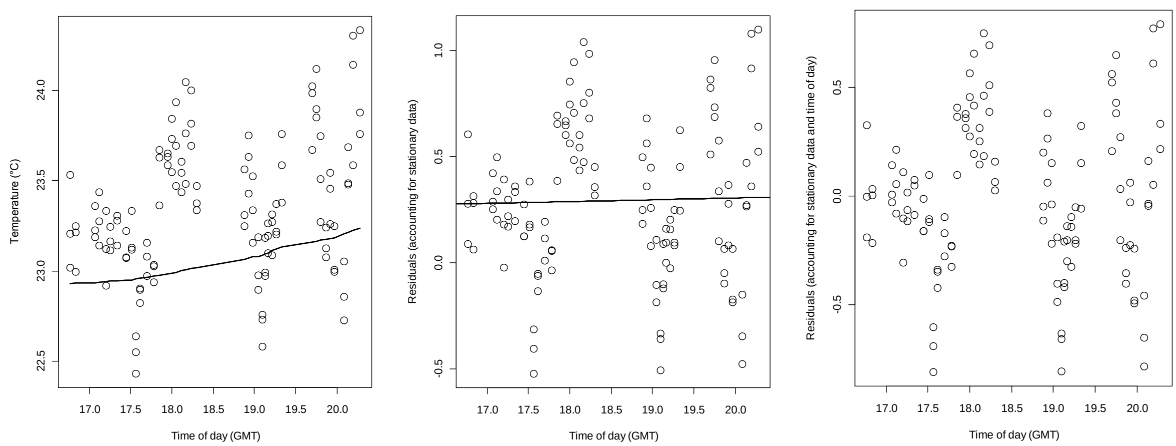


Figure 33. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting for changes temperature in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

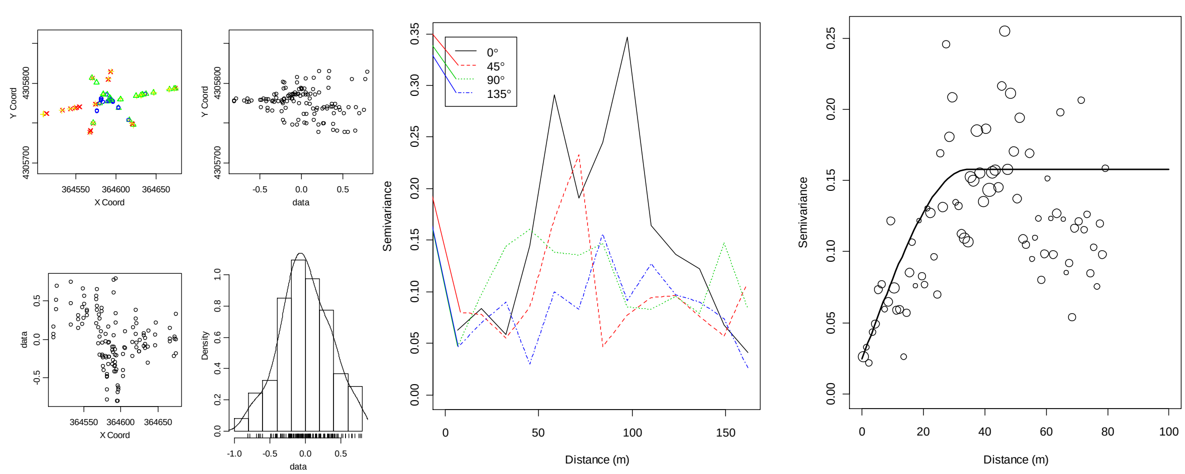


Figure 34. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

4.3.3.2 Soil water content

Soil water content data residuals, after accounting for changes in water content in the stationary data and any remaining time of day trend, were used for the semivariogram analysis (Figure 35). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 36, left graph) and directional semivariograms do not show anisotropy (Figure 36, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 36, right graph). The model indicates a distance of effective independence of 32 m for soil water content.

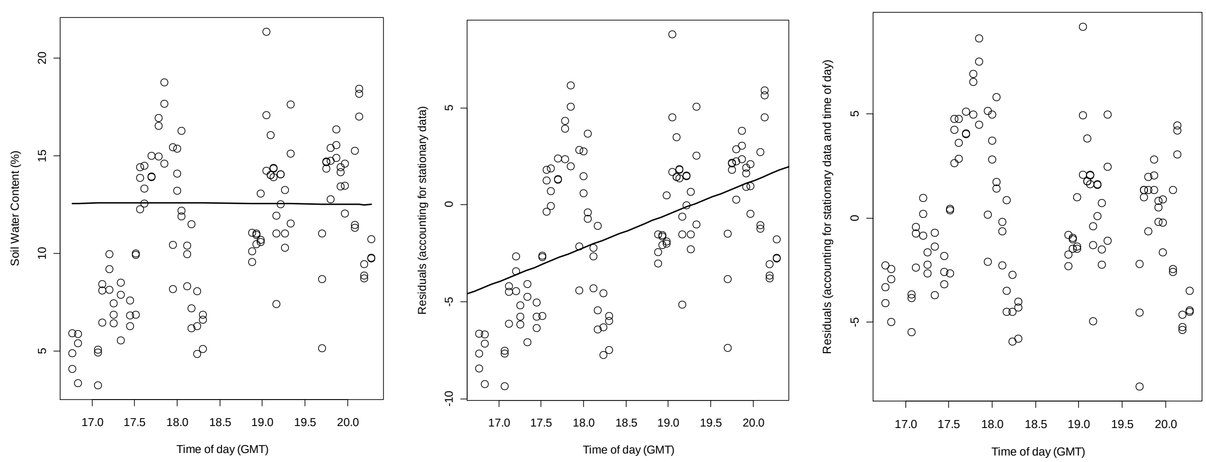


Figure 35. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting 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.

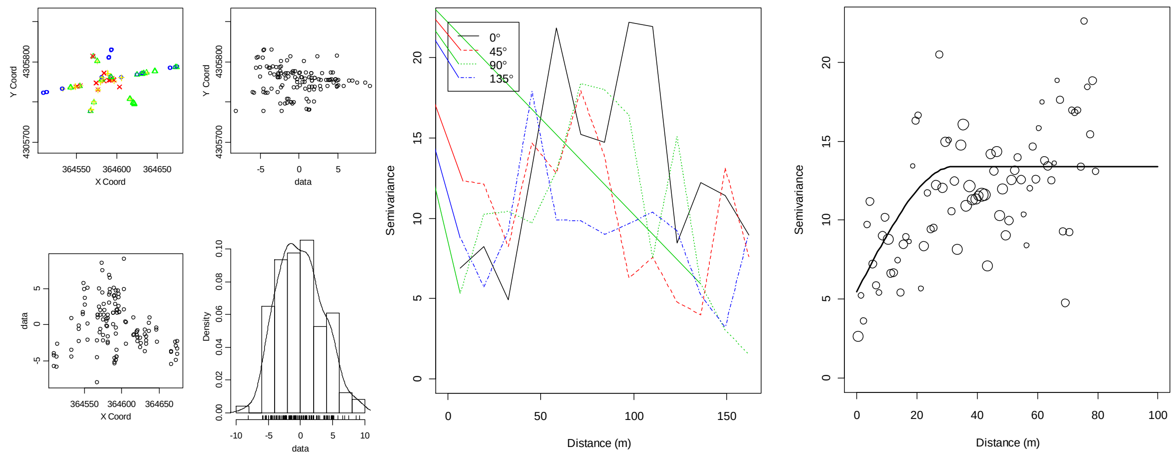


Figure 36. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

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 34 m for soil temperature and 32 m for soil moisture. Based on these results and the site design guidelines the soil plots at SERC shall be placed 34 m apart. The soil array shall follow Soil Array Pattern C due to limited space to avoid crossing the road and also to stay within a dominant soil type, with the soil plots being 5 m x 5 m. The direction of the soil array shall be 285° from the soil plot nearest the tower (i.e., first soil plot, Figure. 38). The location of the first soil plot will be approximately 38.890065°, -76.560215°. The exact location of each soil plot will be chosen by an FIU team member during site construction 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 38.891161, -76.559129 (primary location); or 38.890985, -76.559777 (alternate location 1 if primary location is unsuitable); or 38.891279, -76.558577 (alternate location 2 if primary location is unsuitable). A summary of the soil information is shown in Table 11 and site layout can be seen in Figure 38.

Dominant soil series at the site: Collington-Wist complex, 5 to 10 percent slopes. The taxonomy of this soil is shown below:
Order: Ultisols
Suborder: Udults
Great group: Hapludults
Subgroup: Typic Hapudults
Family: Fine-loamy, mixed, active, mesic Typic Hapludults
Series: Collington-Wist complex, 5 to 10 percent slopes

Table 11. Summary of soil array and soil pit information at SERC.
0° represents true north and accounts for declination.

Soil plot dimensions	5 m x 5 m
Soil array pattern	C
Distance between soil plots: x	34 m
Distance from tower to closest soil plot: y	18 m
Latitude and longitude of 1st soil plot OR direction from tower	38.890065°, -76.560215°
Direction of soil array	285°
Latitude and longitude of FIU soil pit 1	38.891161, -76.559129 (primary location)
Latitude and longitude of FIU soil pit 2	38.890985, -76.559777 (alternate 1)
Latitude and longitude of FIU soil pit 3	38.891279, -76.558577 (alternate 2)
Dominant soil type	Collington-Wist complex, 5 to 10 percent slopes
Expected soil depth	>2 m
Depth to water table	>1.02-2 m

Expected depth of soil horizons	**Expected measurement depths***
0-0.33 m (Fine sandy loam)	0.17 m
0.33-0.43 m (Fine sandy loam)	0.38 m
0.43-1.04 m (Sandy clay loam)	0.74 m
1.04-2 m (Fine sandy loam)	1.52 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.

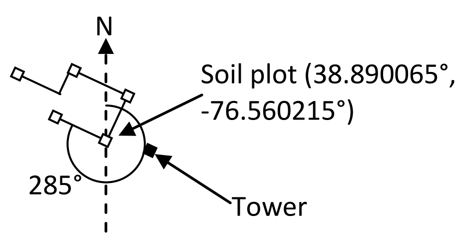


Figure 37. Schematic diagram of soil array layout in relation to tower. Soil plot positions are approximate.

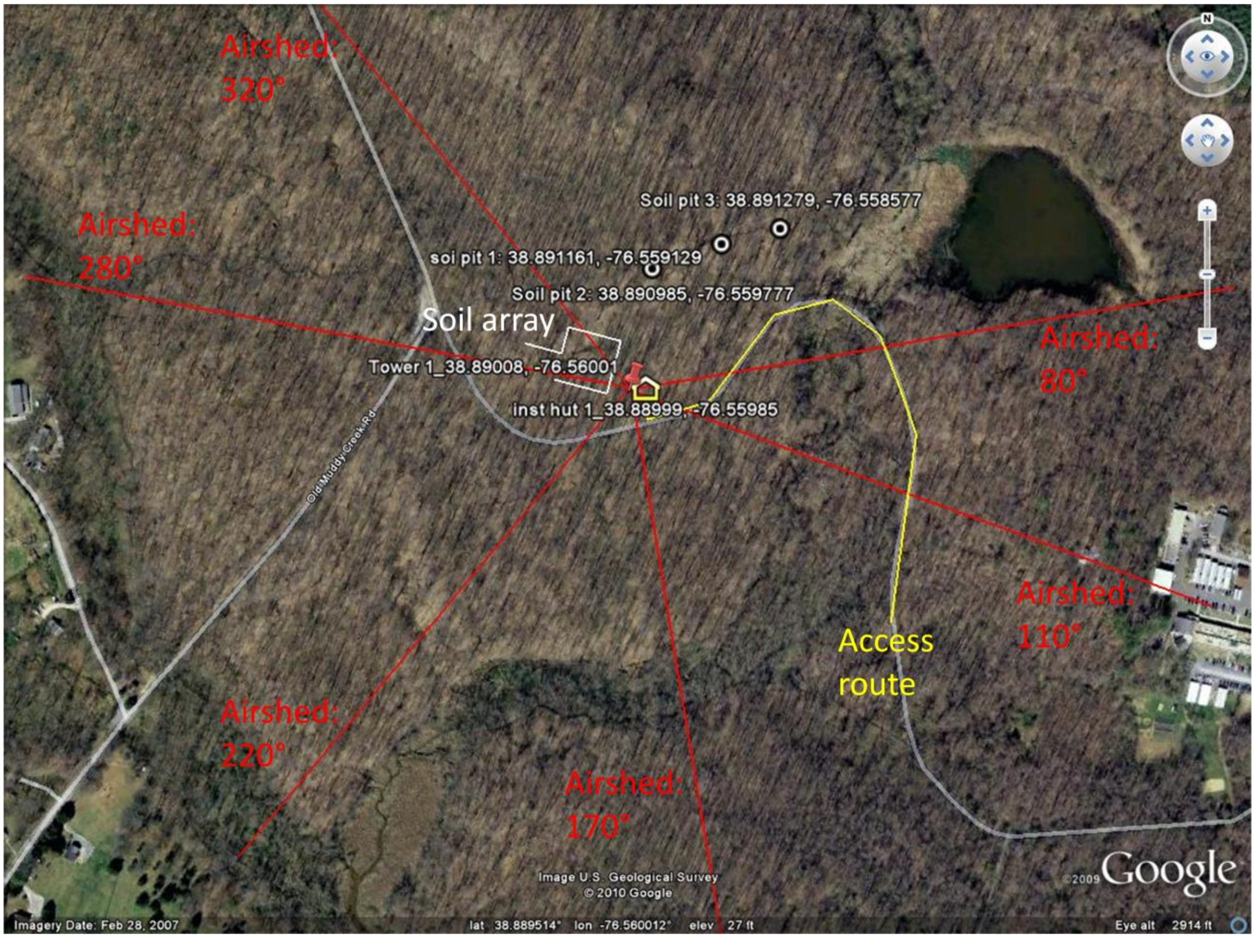


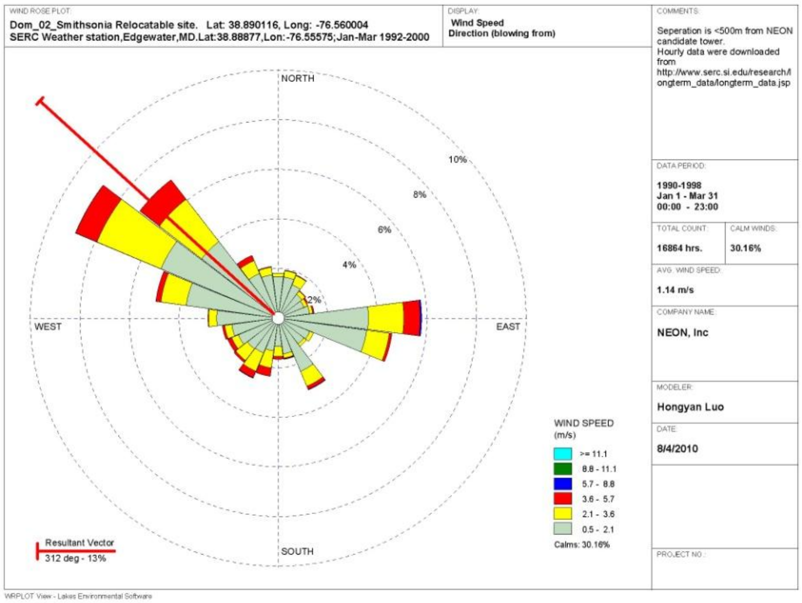
Figure 38. Site layout at SERC showing soil array and location of the FIU soil pit.

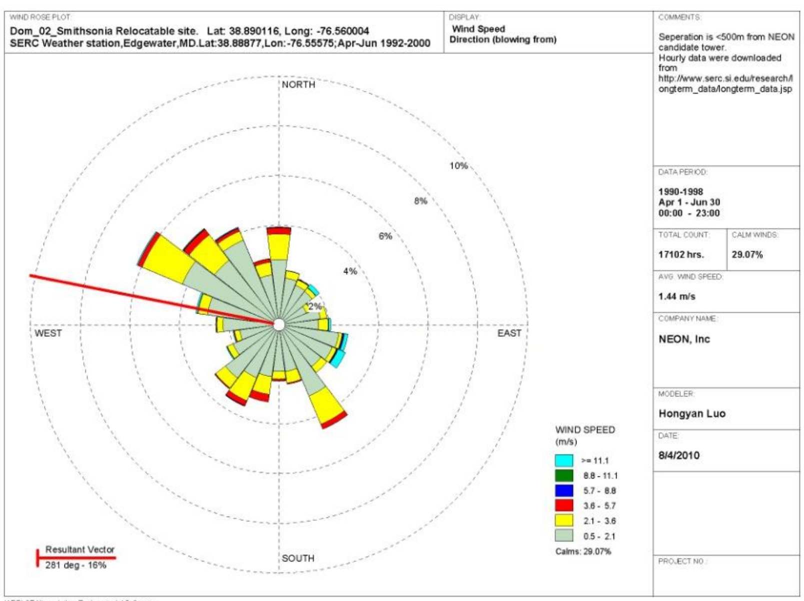
4.4 Airshed

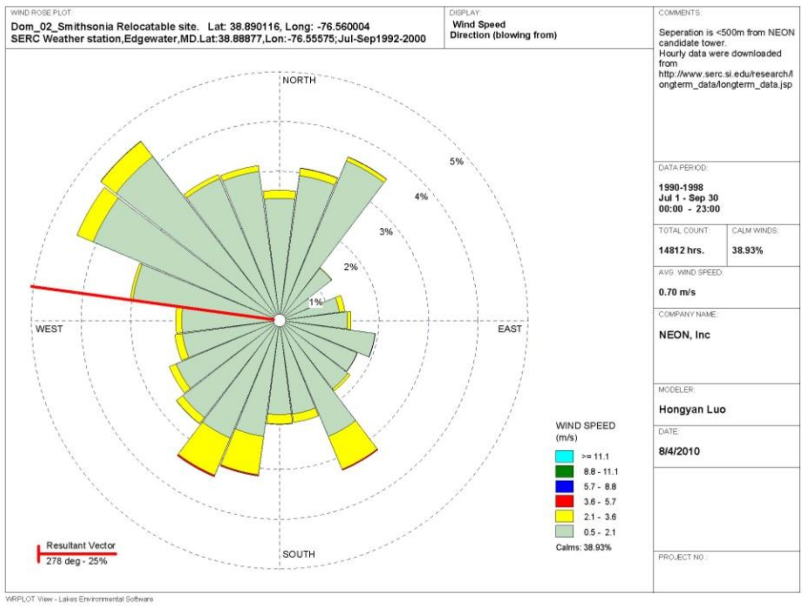
4.4.1 Seasonal windroses

Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given timeseries (Figure 39.1). The weather data used to generate the following wind roses are from SERC weather station at 38.88877, -76.55575, which is <500 m from NEON tower site. Dr Geoffrey (Jess) Parker also provided another set of windrose from his flux tower at 38.8899778, -76.559883 (Figure 39.2, Figure 39.3), which is similar to the SERC weather station windroses. 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)







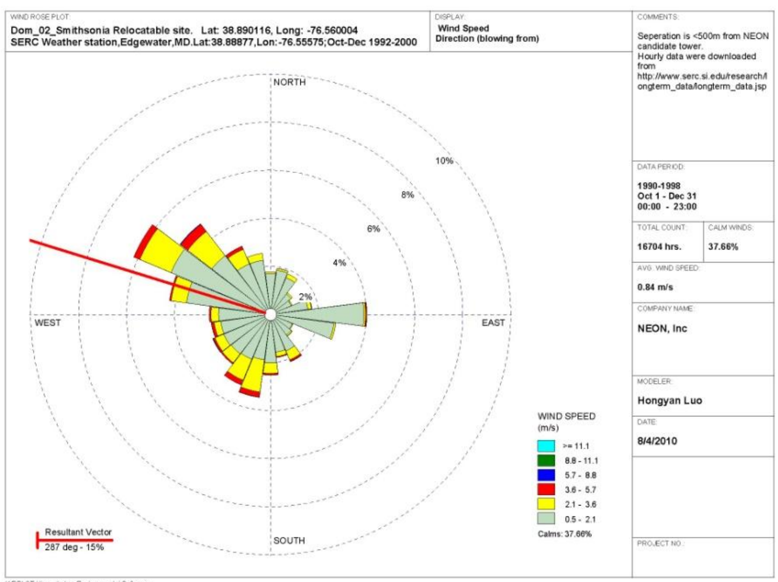


Figure 39.1 Windroses for SERC relocatable site.
Data used here are hourly data from 1992 to 2002 from SERC weather station. Data source: http://www.serc.si.edu/research/longterm_data/longterm_data.jsp. It is assumed that the wind data was corrected for declination. Panels (from Top to bottom), are from Jan-Mar, Apr-Jun, Jul-Sept, and Oct-Dec.

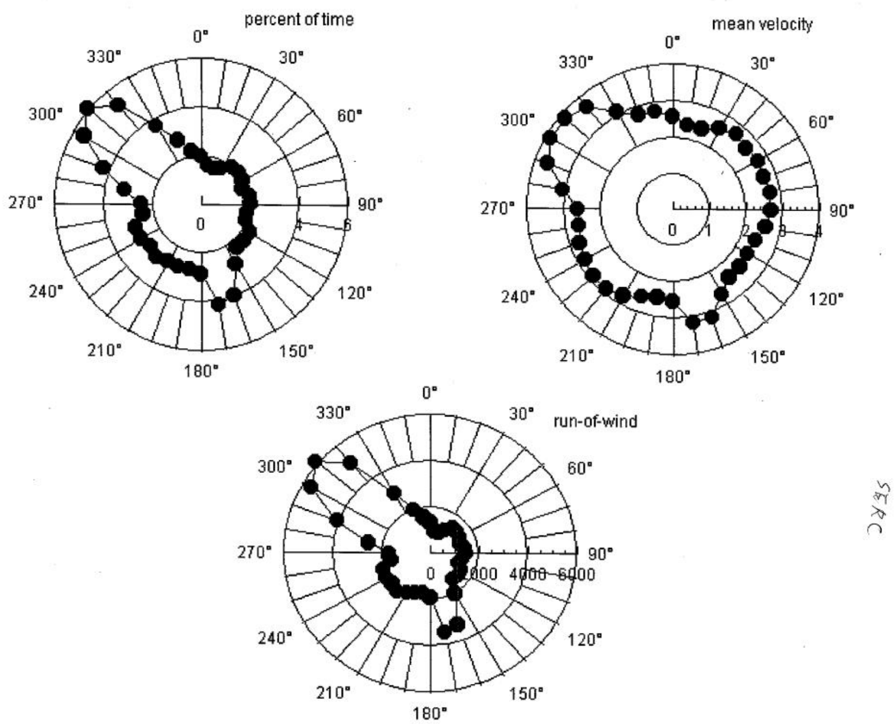


Figure 39.2 Windroses for SERC relocatable site (provided by Dr Geoffrey (Jess) Parker).

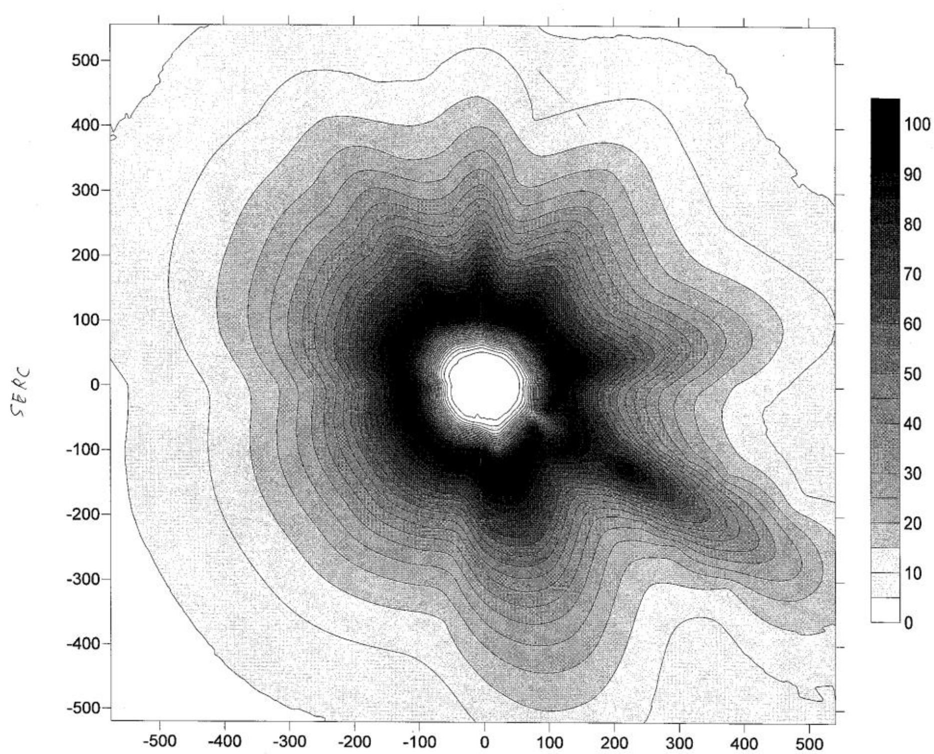


Figure 39.3 Volcano view of windroses for SERC relocatable site (provided by Dr Geoffrey (Jess) Parker).

4.4.3 Resultant vectors

Table 12. The resultant wind vectors from SERC weather station for SERC relocatable tower using hourly data from 1992 to 2000.

Quarterly (seasonal) timeperiod	Resultant vector	% duration
January to March	312°	13
April to June	281°	16
July to September	278°	25
October to December	287°	15
Annual mean	289.5°	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 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 verified 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 13. Expected environmental controls to parameterize the source area model, and associated results from SERC 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	60	60	60	60	60	60	m
Canopy Height	38	38	38	38	38	38	m
Canopy area density	4	4	4	1.5	1.5	1.5	m
Boundary layer depth	2000	2000	900	900	900	700	m
Expected sensible heat flux	450	450	-25	180	180	-75	W m^{-2}
Air Temperature	30	30	20	1	1	1	°C
Max. windspeed	5.0	1.8	0.5	8.5	2.5	1.8	m s^{-1}
Resultant wind vector	150	150	315	90	90	300	degrees
Results							
(z-d)/L	-0.23	-0.65	3.00	-0.03	-0.32	3.00	m
d	31	31	31	28	28	28	m
Sigma v	2.40	2.10	1.60	2.80	1.50	1.60	m^2 s^{-2}
Z0	1.50	1.50	1.50	2.30	2.30	2.30	m
u*	0.84	0.60	0..01	1.40	0.60	0.04	m s^{-1}
Distance source area begins	20	0	900	50	0	1000	m
Distance of 90% cumulative flux	800	250	3850	1450	550	3800	m
Distance of 80% cumulative flux	500	180	3500	850	350	3600	m
Distance of 70% cumulative flux	380	100	3350	600	250	3400	m
Peak contribution	105	25	3825	135	65	3995	m

4.4.5 Results (source area graphs)

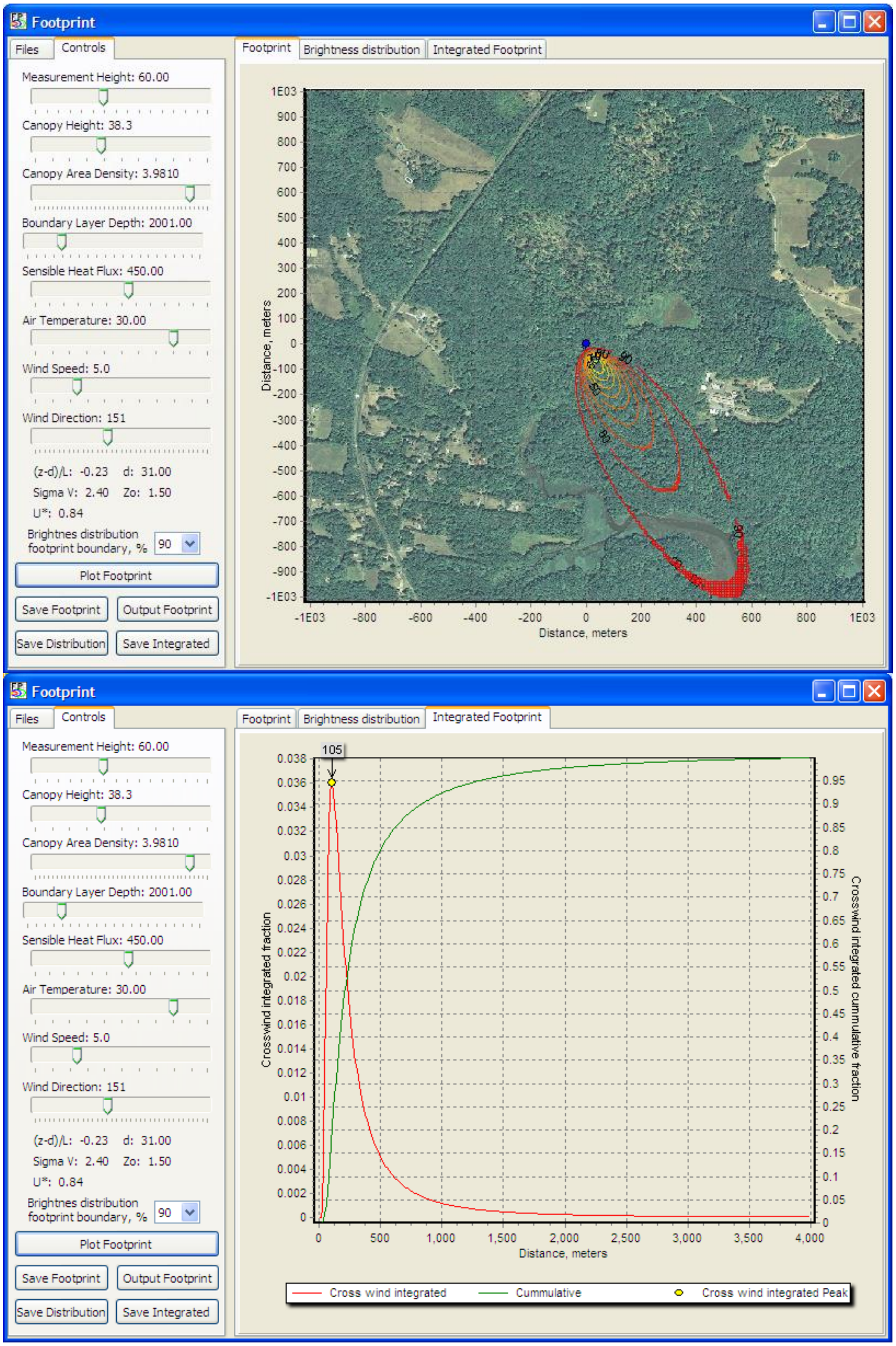


Figure 40. SERC summer daytime (convective) footprint output with max wind speed.

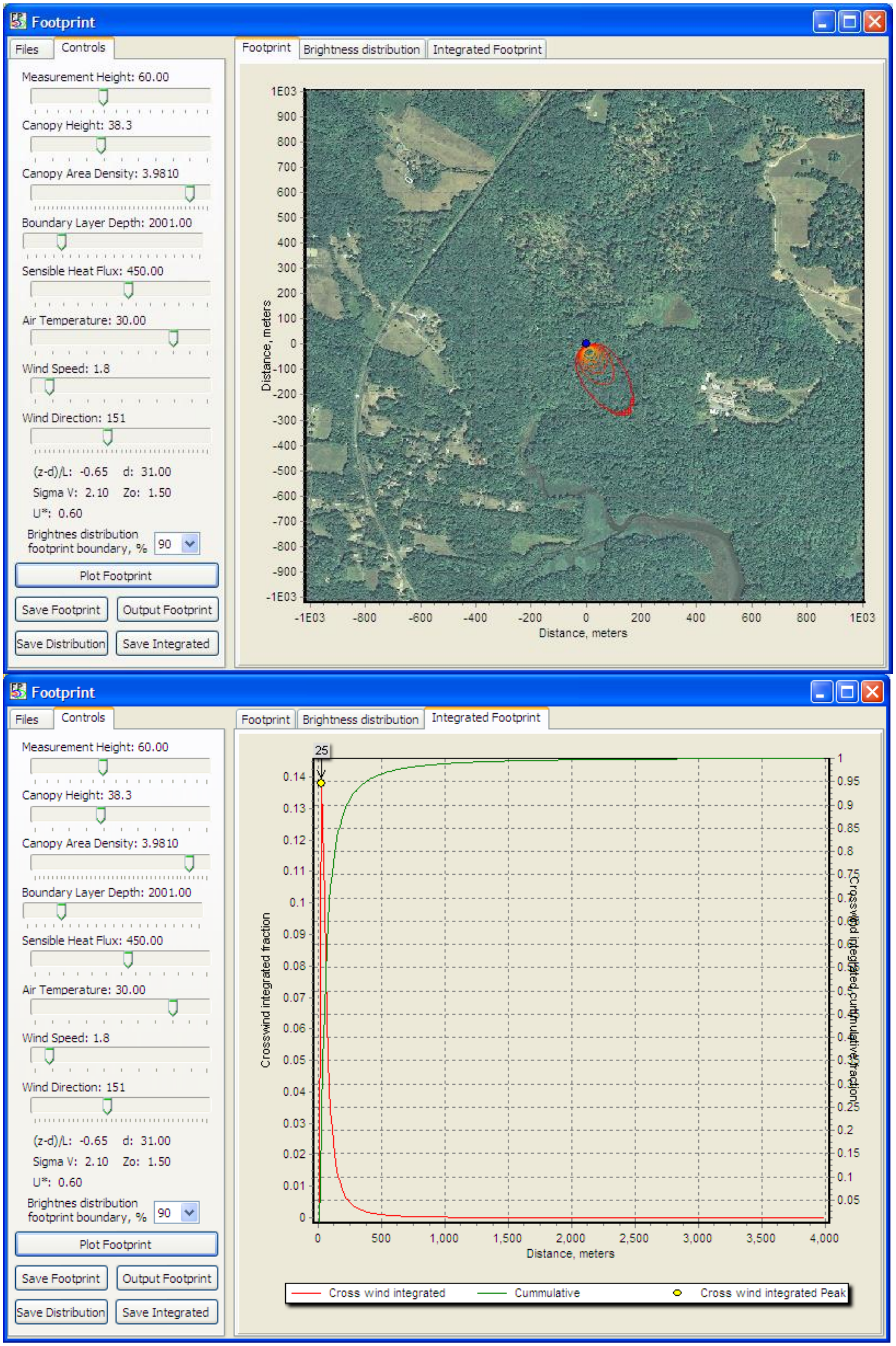


Figure 41. SERC summer daytime (convective) footprint output with mean wind speed.

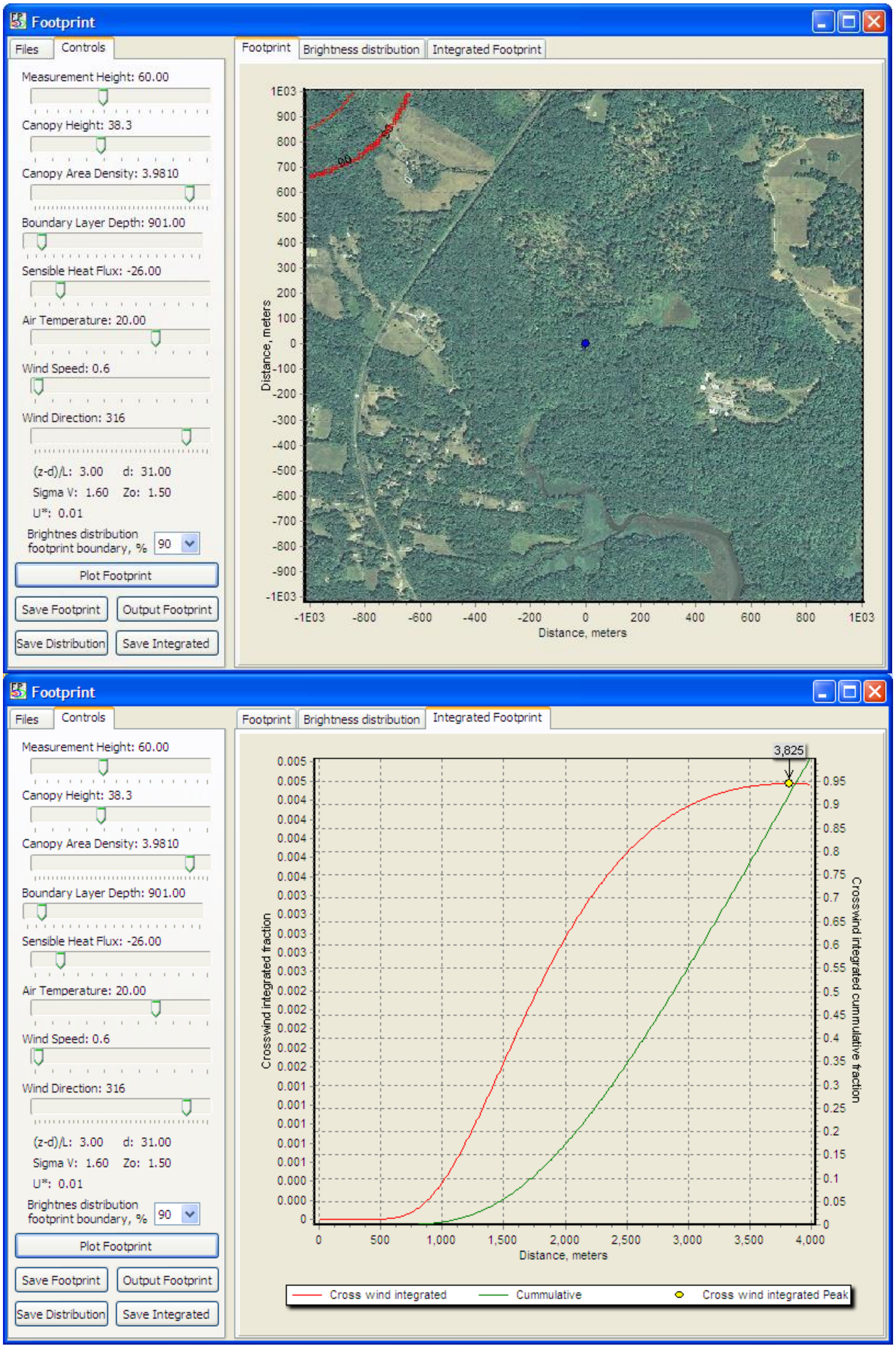


Figure 42. SERC summer nighttime (stable) footprint output with mean wind speed.

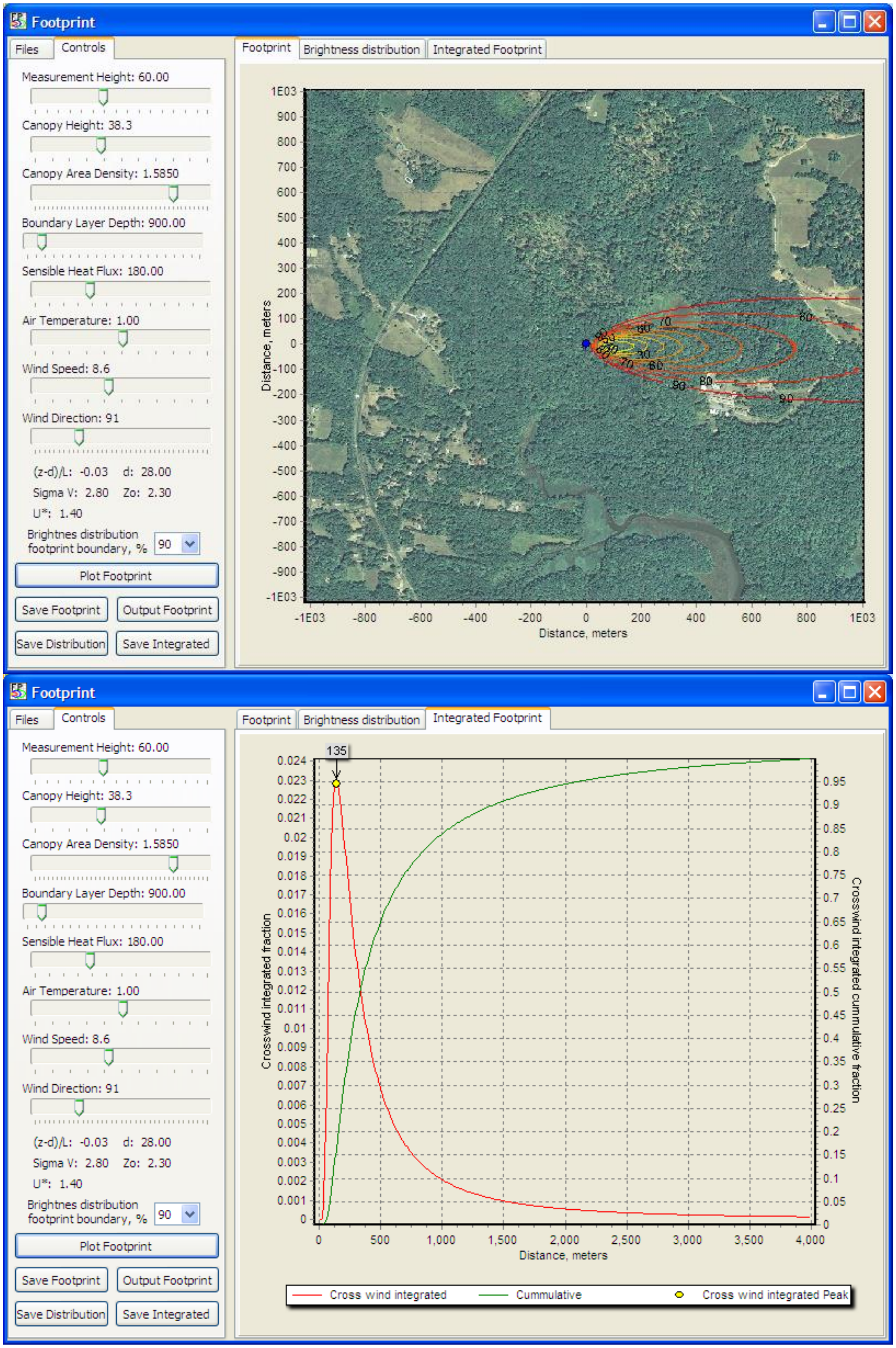


Figure 43. SERC winter daytime (convective) footprint output with max wind speed.

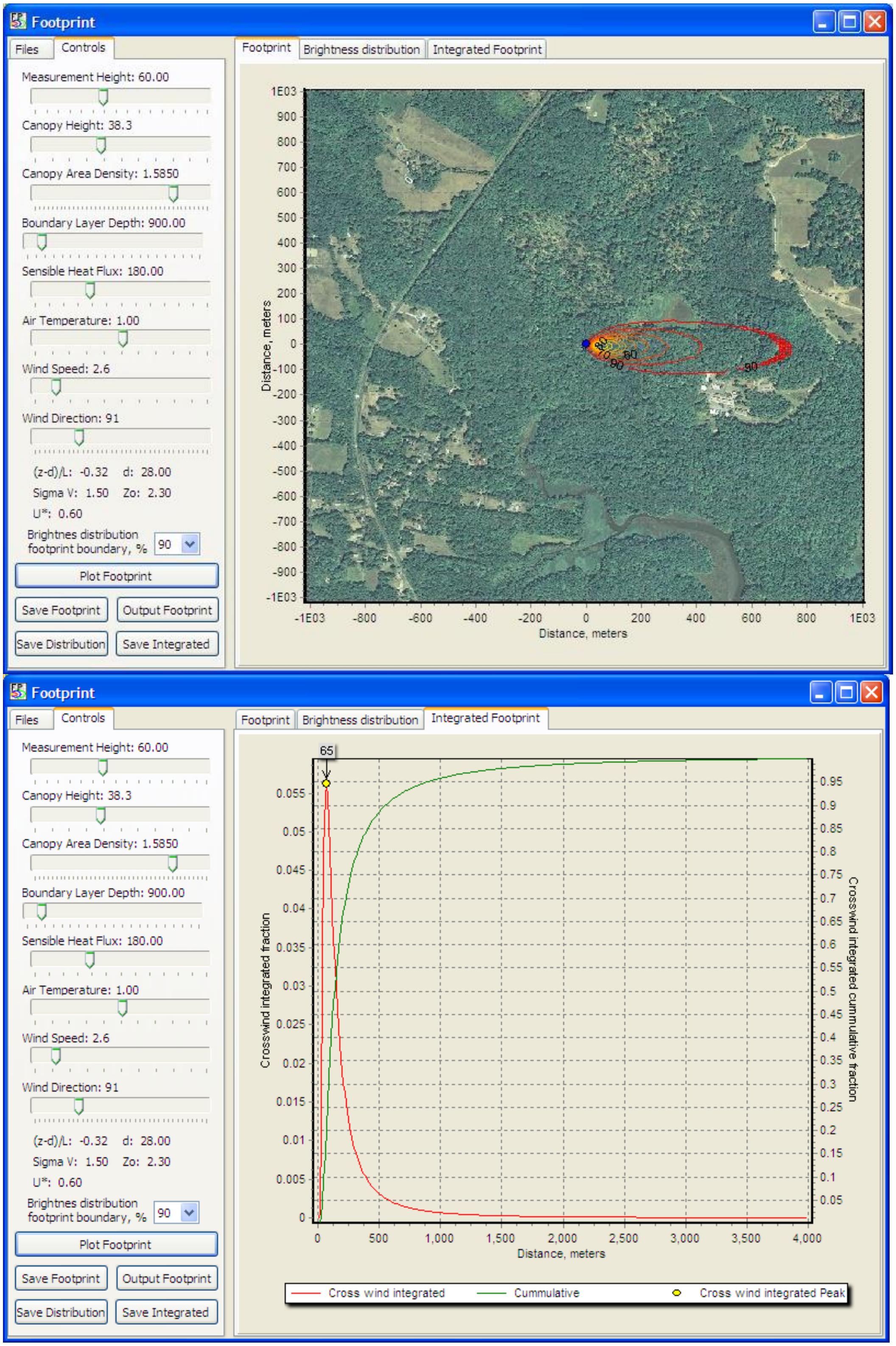


Figure 44. SERC winter daytime (convective) footprint output with mean wind speed.

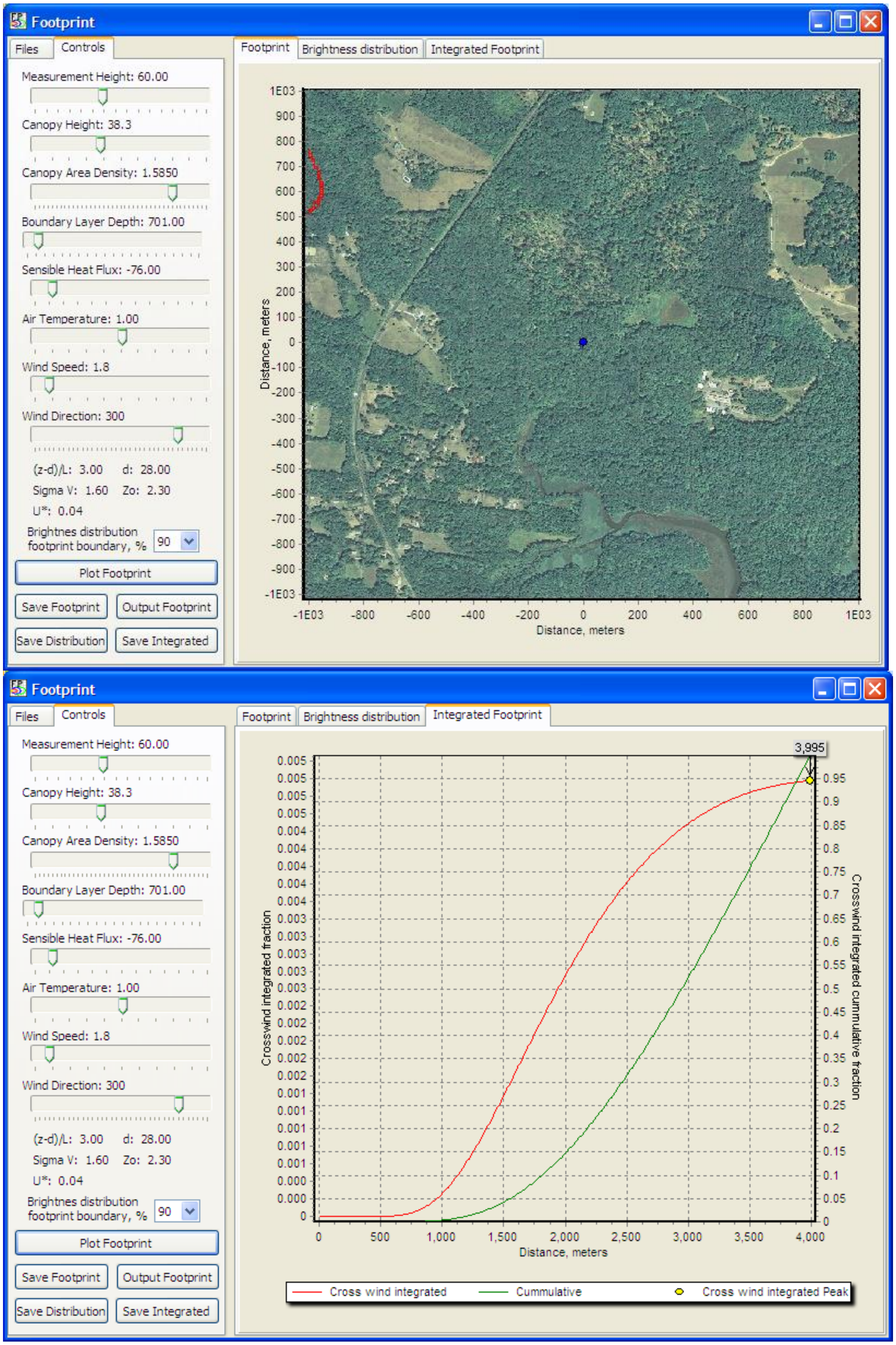


Figure 45. SERC winter nighttime (stable) footprint output with mean wind speed.

4.4.6 Site design and tower attributes

According to wind roses, the prevailing wind direction blows from northwest (280° to 320°, clockwise from 280°) and from South (170° to 220°, clockwise from 170°), secondary airshed includes wind from 80° to 110° (clockwise from 80°). Tower should be placed to a location to best catch the signals from the airshed of the ecosystem in interest, which is tulip popular-oak forest. The tower site on EHS' list is 38.890116°, 76.560004°, which was converted from the northing and easting coordinates in the previous site visit in 2008. We were told that error was possibly introduced during conversion. Dr Geoffrey (Jess) Parker confirmed that the coordinates he provided to NEON before were his existing flux tower location. We agreed that taking down his tower and build NEON's tower at the same location is the best option to minimize disturbance to the ecosystem and current research activities, and have the best fetch area from all directions in the preserved forest. The director of SERC, Tuck Hines, thought that having the NEON tower to occupy the very site of the current SERC tower is worth considering. Therefore, during FIU site characterization, we re-took the GPS points at his tower site, which is 38.89008, -76.56001. Power is available at this site.

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 ESE side of tower and have the longer side parallel to NW-SE direction. Because this is a closed canopy ecosystem, the distance between the tower and the instrument hut can be reduced to ~ 15 m. Therefore, we suggest the placement of instrument hut at 38.88999, -76.55985.

Canopy height is 38 m around tower site with lowest branches at 10 m above ground level. Oak recruitments form upper understory, which vary from 3 to 15 m in height without obvious strata. Seedlings and sapling of ash and oak forms the lower understory with height 0.5-1.5 m. Ferns and new recruitment of ash and oak form the understory at ground level with height ~ 0.3 m. Grass and other annuals are not common at this site. We require 6 **measurement layers** on the tower with top measurement height at 60 m, and rest layers are 42 m, 28 m, 15 m, 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. **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. 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, in this case, level 6 being the upper most level at this tower site.

Table 14. Site design and tower attributes for SERC Relocatable 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			280° to 320 and 170° to 220° (major), 80° to 110° (secondary)		Clockwise from first angle
Tower location	38.89008,	-76.56001	--	--	Same site, new GPS
Instrument hut	38.88999,	-76.55985			
Instrument hut orientation vector	--	--	120°-300°		
Instrument hut distance z	--	--	--	15	
Anemometer/Temperature boom orientation	--	--	230°	--	
Height of the measurement levels					
Level 1				0.2	m.a.g.l.
Level 2				5.0	m.a.g.l.
Level 3				15.0	m.a.g.l.
Level 4				28.0	m.a.g.l.
Level 5				42.0	m.a.g.l.
Level 6				60.0	m.a.g.l.
Tower Height				60.0	m.a.g.l.

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

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

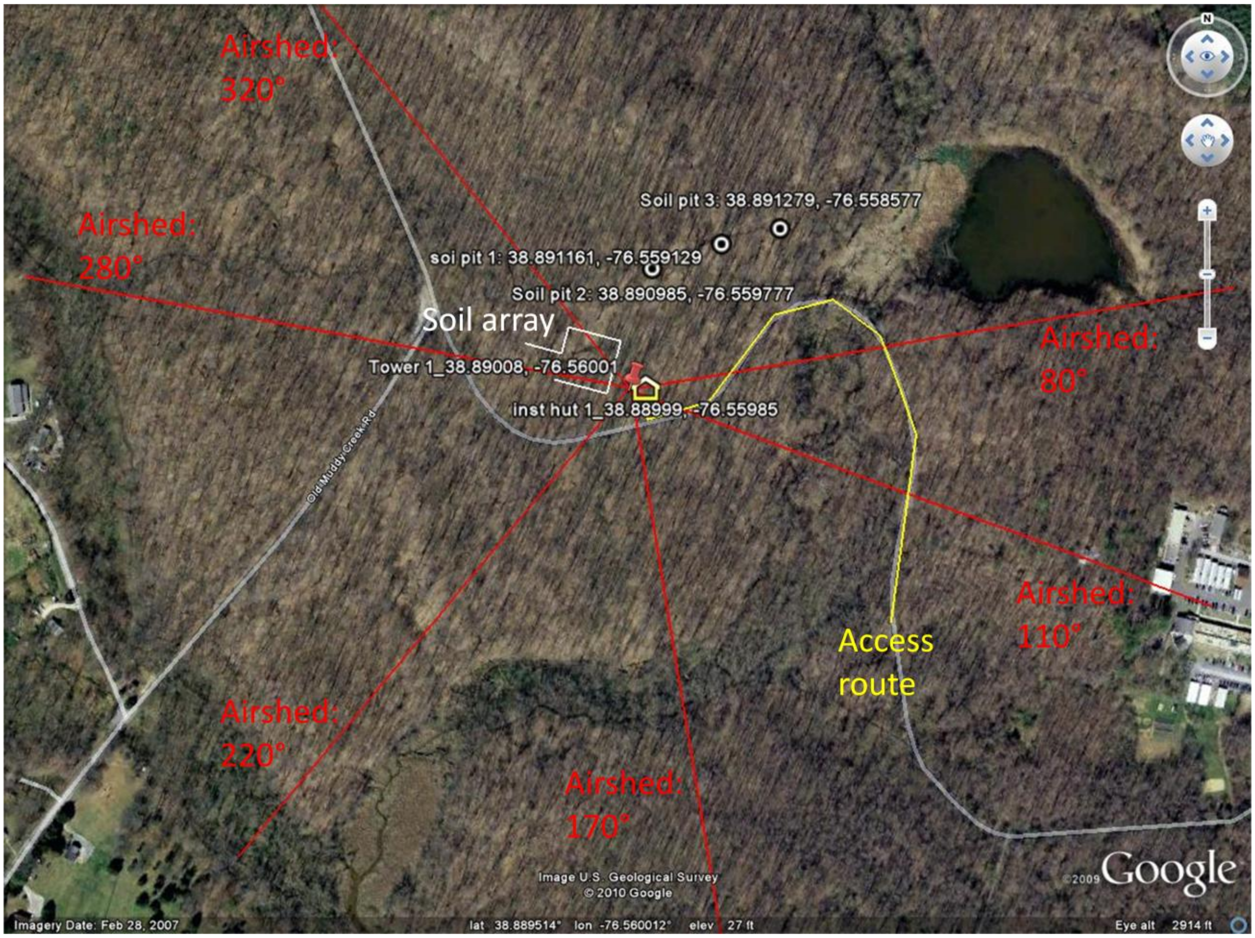


Figure 46. Site layout for SERC Relocatable site.

i) new tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors of 280^o to 320^o (major airshed, clockwise from 280^o) and 170^o to 220^o (clockwise from 170^o), and 80^o to 110^o (secondary airshed, clockwise from 80^o) 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. 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 the SERC site

- Boardwalk is from the access paved road to instrument hut. SERC does not have any specific requirement about boardwalk.
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- Boardwalk required from the instrument hut 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:

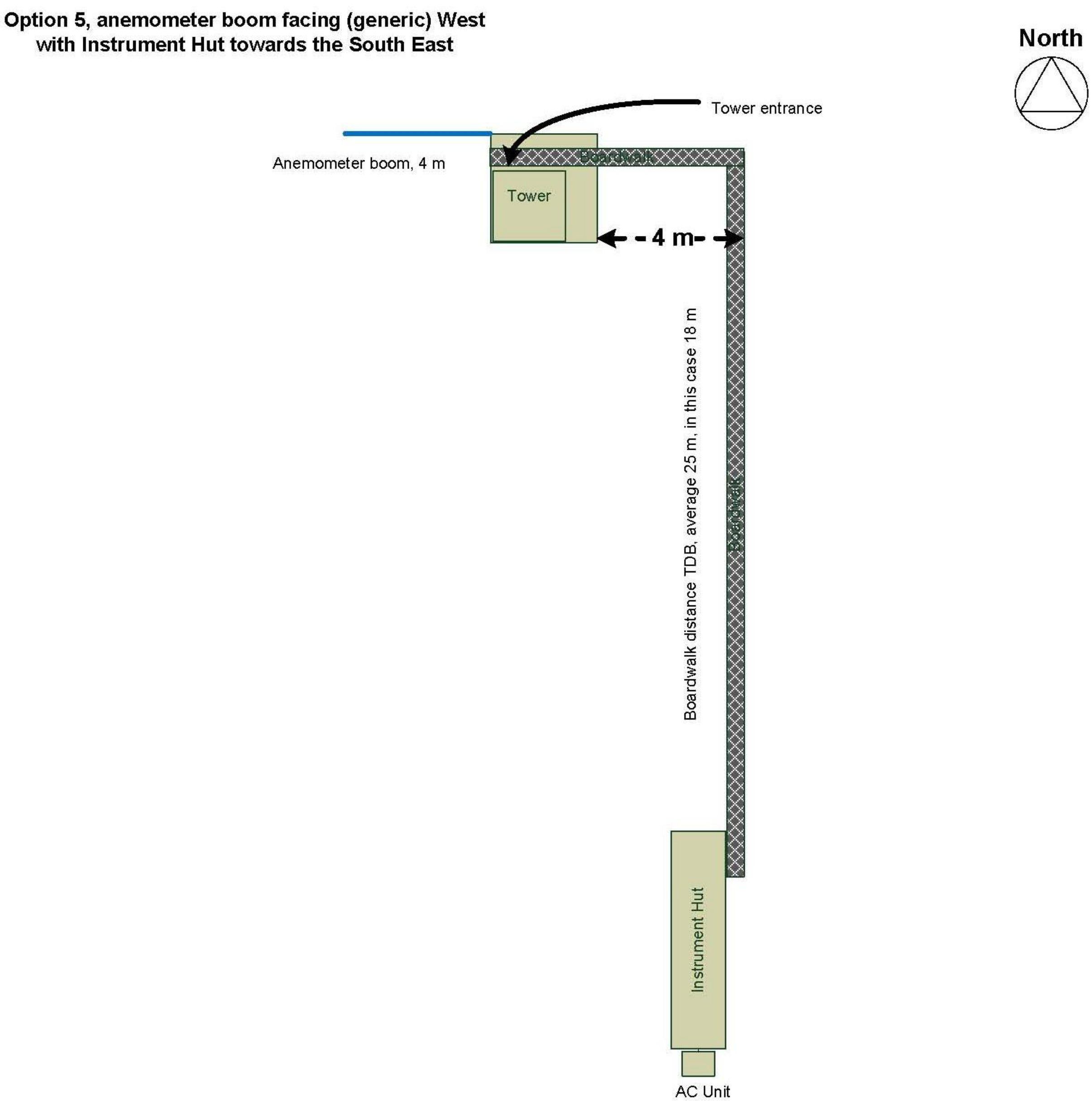


Figure 47. Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the south towards the tower.

This is just a generic diagram. The actual design of boardwalk (or path if no boardwalk required) and instrument hut position will be the responsibility of FCC and LAD following FIU's guidelines. At SERC relocatable site, the boom angle will be 230 degrees, instrument hut will be on the southeast towards the tower, the distance between instrument hut and tower is ~15 m. The instrument hut vector will be SE-NW (120^o-300^o).

4.4.7 Information for ecosystem productivity plots

The tower at SERC Relocatable site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (hardwood forest). Major airshed at this site from northwest (280^o to 320^o, clockwise from 280^o) and from South (170^o to 220^o, clockwise from 170^o), and secondary airshed from 80^o to 110^o (clockwise from 80^o). Most of the time, 90% signals for flux measurements are within a distance of 800 m from tower, and 80% within 500 m. We suggest FSU Ecosystem Productivity plots to be placed within the major airshed boundaries of 280^o to 320^o (clockwise from 280^o) from tower.

4.5 Issues and attentions

Research activities are active at this site. Tower location at the existing tower location is our first recommendation for NEON tower location, which can minimize disturbance and impacts during construction, minimize the conflicts with other research projects, and is also the preference option of SERC. Power is available at site. Paved road lead to tower location within 100 m, which make the accessibility very convenient. Paved road is ~ 6 m wide and currently open 2 hours daily for public traffic. After the major road is paved (it is ongoing and expect to be finished soon), this paved road will be closed for public use, thus has very limit impacts of car gas emission and security concerns. The director of SERC, Tuck Hines, also thought that having the NEON tower to occupy the very site of the current SERC tower is worth considering. However, if for any reason above location doesn't work, the second option of our tower location and instrument hut location are inside SERC plots (Tower 2_38.89057, -76.56079, Inst hut 2_38.89055, -76.56070), where every single tree with diameter > 1cm will be monitored and measured periodically. Dr Geoffrey (Jess) Parker also has long term experiment set up here for over 15 years. This tower location is very close to selective logging area (~70 m), edge effects between these two different density ecosystems could be a concern. Dr Geoffrey (Jess) Parker picked this second set of tower and instrument hut locations with FIU team at field.

Dr Geoffrey (Jess) Parker required us to do site layout design and send to him for comments, so that he can check our design layout with existing research projects at SERC. Dr Geoffrey (Jess) Parker also wants all NEON facilities stays on the west side of red stake line between SERC plot 4 and 8. We may have to adjust our soil plots location accordingly to minimize the conflicts. We assume this will be EHS's responsibility to present our site layout and communicate with SERC, then get back to FIU team for further discussion.

5 BLANDY EXPERIMENTAL FARM, RELOCATEABLE TOWER 2

5.1 Site description

The NEON candidate relocatable tower site (39.0621, -78.05446667) is located at the northeast corner of Blandy Experimental Farm (Figure 48). Blandy Experimental Farm is a 700-acre University of Virginia research facility situated in the northern Shenandoah Valley, about 10 miles east of Winchester and 60 miles west of Washington, D.C. Blandy Experimental Farm is also the home of the State Arboretum of Virginia, displaying more than 8,000 trees and woody shrubs. The collections include nearly half the world's pine species, the Virginia Native Plant Trail, the Boxwood Memorial Garden, a spectacular grove of more than 300 ginkgo trees, an herb garden featuring culinary, medicinal and ornamental herbs, and much more. Given to the University of Virginia in 1926, the sole stipulation of the contract was that the land be used "to teach boys about farming". (info source: http://www.virginia.edu/blandy/). The detailed description about Blandy Experimental Farm and the research activities can be found in this paper: M. A. Bowers, University of Virginia's Blandy Experimental Farm, *Bulletin of the Ecological Society of America.* Vol. 78, No. 3 (Jul., 1997), pp. 218-219.

According to the wind roses and footprint analysis, the major fetch area for the candidate tower site (39.0621, -78.05446667) is from the experimental area, which contains 20 plots at different ecosystem succession stages as a result of plowing at different frequencies. This will make it difficult to interpret the flux signals from this area due to the fragmented surface. After FIU site characterization, the tower location was microsited to 39.06026, -78.07164 in an abandoned old field.

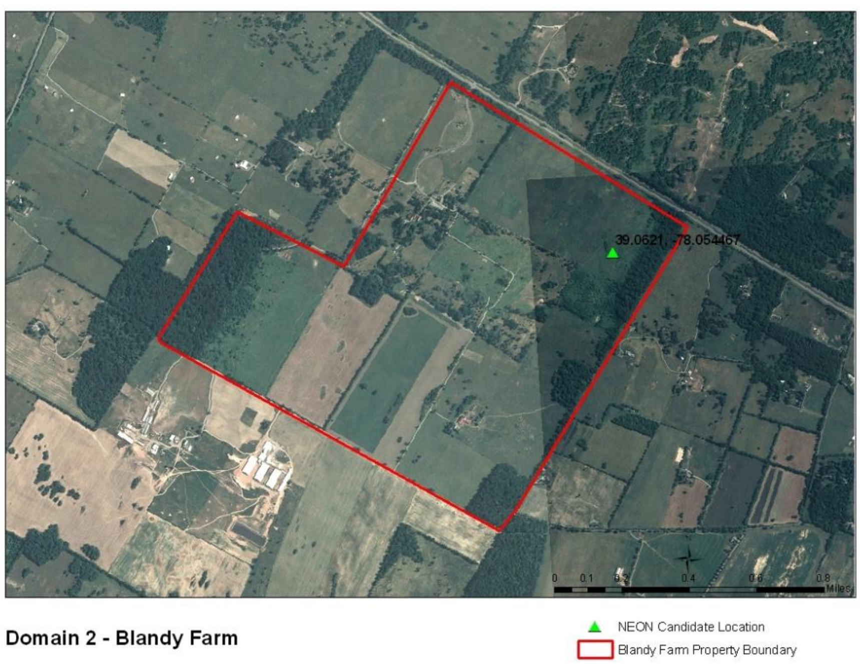


Figure 48. Blandy Experimental Farm property boundary and candidate tower location.

5.2 Ecosystem

Blandy features a group of Metasequoias that have grown fairly well, but not nearly as well as ones on the Maryland side of Washington, D.C. This indicates that the windier, mountainous climate of the Shenandoah is not the best for Metasequoias. To the west of Blandy is the Central Appalachian broadleaf forest, and to the east is the Southern mixed forest. The Hardiness Zone is zone 6, a temperate zone. It is in a valley of relatively high winds though, likely not helping growth. Precipitation is average, and the dominant soil orders are Inceptisols and Ultisols (http://www.skidmore.edu/gis/research/metasequoia/Blandy.htm).

More vegetation and land cover information are presented below:

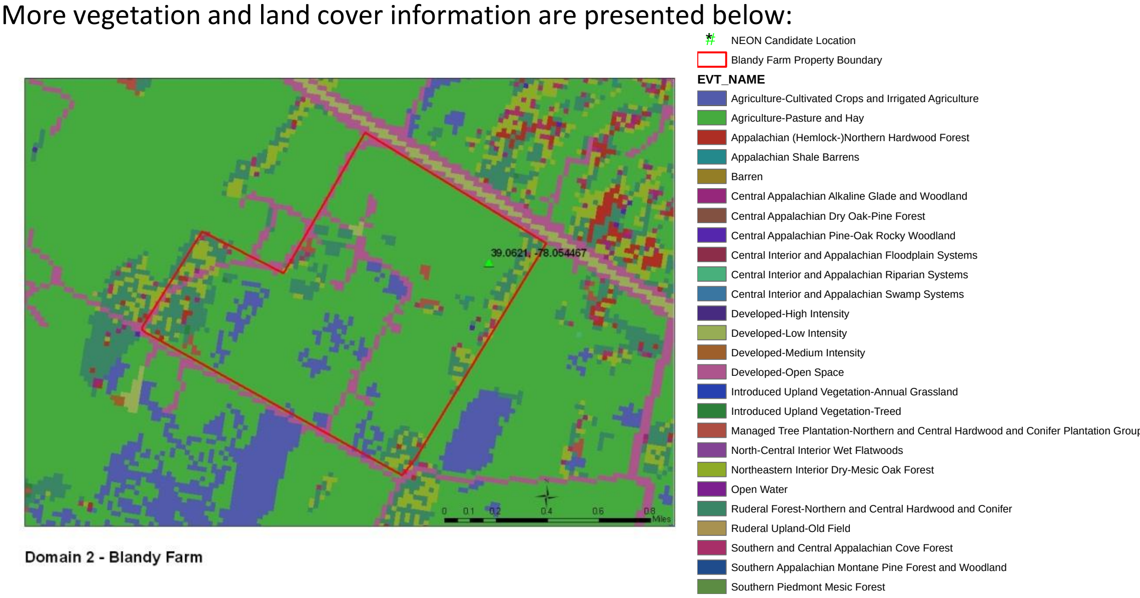


Figure 49. Vegetative cover map of Blandy Experimental Farm relocatable site and surrounding areas (from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm)

Table 15. Percent Land cover information at Blandy Experimental Farm relocatable site (from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm)

Vegetation Type	**Area**	**Percentage**
Developed-Open Space	0.130372039	4.86099444
Developed-Low Intensity	0.0054	0.20134202
Agriculture-Pasture and Hay	1.998663231	74.5212772
Agriculture-Cultivated Crops and Irrigated Agriculture	0.142772755	5.32336208
Introduced Upland Vegetation-Treed	0.0027	0.10067101
Northeastern Interior Dry-Mesic Oak Forest	0.114038864	4.25200288
Southern and Central Appalachian Cove Forest	0.013752699	0.51277709
Appalachian Shale Barrens	0.0009	0.033557
Appalachian (Hemlock-)Northern Hardwood Forest	0.009967652	0.37164947
Central Appalachian Pine-Oak Rocky Woodland	0.00057635	0.02148952
Central Appalachian Alkaline Glade and Woodland	0.002416192	0.09008906
Central Interior and Appalachian Floodplain Systems	0.000616191	0.02297504
Ruderal Forest-Northern and Central Hardwood and	0.243024296	9.06129691

Conifer		
Managed Tree Plantation-Northern and Central Hardwood and Conifer Plantation Group	0.016803187	0.62651622
Total Area Sq Km	2.682003456	100

After the tower location was miscrosited to 39.06026°, -78.07164° in abandoned old farm fields, which is under sucessional processes. Goldenrod (*Solidago altissima,* in more recent abandon farm field) and shrub common buckthorn (*Rhamnus cathartica,* in older abandoned farm field) are dominant vegetation in the major airshed on northwest to tower location. Invasive species are common in this area. Common buckthorn (*Rhamnus cathartica*) is the dominant invasive plants in this field, although there is some disagreement about the species identification (per personal communication with Dr David Carr). FIU measurements can be tied to the FSU study about invasive species here. The major ecosystem in the secondary airshed on the south to the tower location is hay or corn, depending on farmers' decision. Although ideally we wish to have a homogenous surface in the tower airshed for flux measurements, two ecosystems in our airshed will have less uncertainty than 20 different plots when interpreting flux signals.

Canopy height is ~1.2 m (varies from 0.5 m to 2.5 m) around tower site with lowest branches at ground level at old field area. Canopy height is ~0.5 m for the hay farm land. No understory layers are present. Windbreak trees are ~ 400 m on the west of tower location, which is >> 5x of the mean canopy height (~25 m), thus wake effect and edge effect are not major concerns.

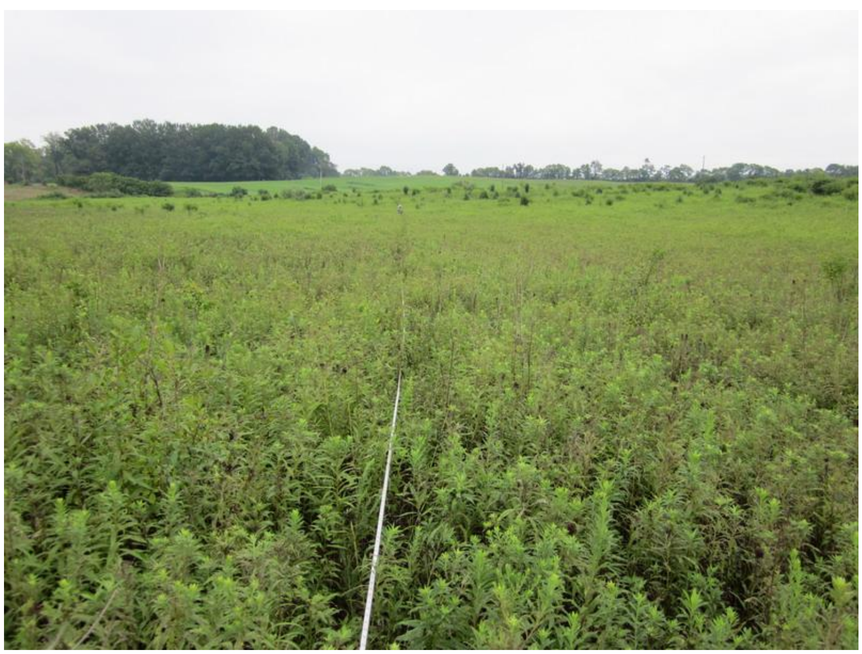


Figure 50 Goldenrod (*Solidago altissima*) is one of the dominant vegetation types in the major airshed

Figure 51 Hay is the dominant ecosystem type in secondary airshed during FIU site characterization

Table 16. Ecosystem and site attributes for the Blandy Experimental Farm Relocatable site.

Ecosystem attributes	Measure and units
Mean canopy height[a]	1.2 m in major airshed /0.5 m in secondary airshed
Surface roughness[a]	0.2 m/0.05
Zero place displacement height[a]	0.8 m/0.35
Structural elements	Abandoned old farm field / hay farmland
Time zone	Eastern time
Magnetic declination	11° 5' W changing by 0° 0' W/year

Note, [a] From field survey.

5.3 Soils

5.3.1 Description of soils

Soil data and soil maps (Figures 52) below for Blandy tower site were collected from 2.2 km^2 NRCS soil maps (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm), which centered at the tower location, 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(s) present in the tower footprint.

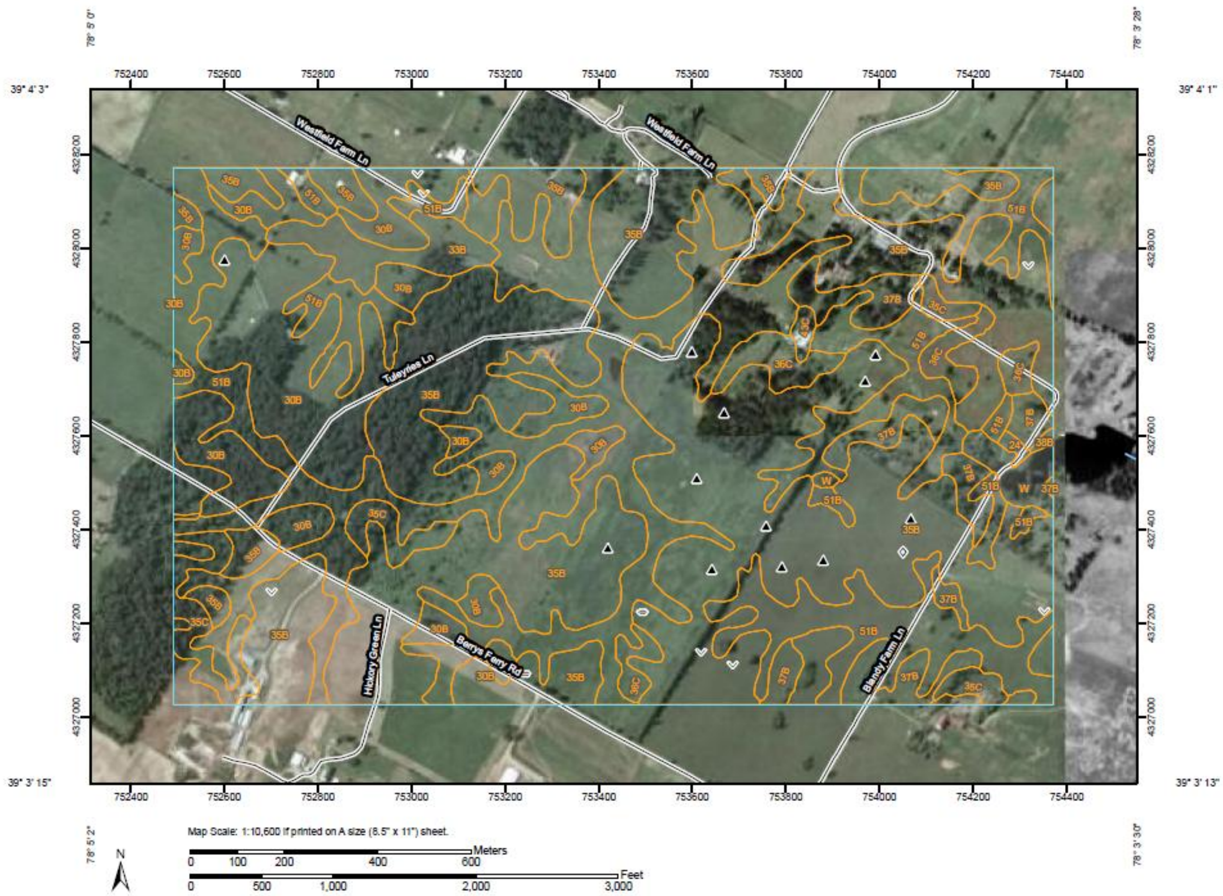


Figure 52. Soil map of the Blandy relocatable site and surrounding areas.

Map Unit Description The map units delineated on the detailed soil maps in a soil survey represent 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, 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 soil types 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, is 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 17. Soil series and percentage of soil series within 2.2 km^2 centered on the Blandy tower

Clarke County, Virginia (VA043)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
24	McGary silty clay loam	0.6	0.1%
30B	Nicholson-Duffield silt loams, 3 to 8 percent slopes	68.9	12.9%
33B	Pagebrook silty clay loam, 0 to 7 percent slopes	9.2	1.7%
35B	Poplimento silt loam, 3 to 8 percent slopes	255.1	47.9%
35C	Poplimento silt loam, 8 to 15 percent slopes	13.7	2.6%
36C	Poplimento silt loam, rocky, 8 to 15 percent slopes	11.4	2.1%
37B	Poplimento-Rock outcrop complex, 3 to 15 percent slopes	21.5	4.0%
38B	Poplimento-Webbtown complex, 3 to 8 percent slopes	0.3	0.1%
43C	Rock outcrop-Opequon complex, 3 to 45 percent slopes	1.1	0.2%
51B	Timberville silt loam, 0 to 7 percent slopes	145.6	27.4%
W	Water	4.7	0.9%
Totals for Area of Interest		**532.1**	**100.0%**

Clarke County, Virginia - 24—McGary silty clay loam: Map Unit Setting Elevation: 340 to 800 feet Mean annual precipitation: 29 to 43 inches Mean annual air temperature: 50 to 55 degrees F Frost-free period: 125 to 198 days **Map Unit Composition** Mcgary and similar soils: 80 percent Minor components: 5 percent **Description of Mcgary Setting** Landform: Flood plains Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium **Properties and qualities** Slope: 0 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 12 to 36 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 8.6 inches) **Interpretive groups** Land capability (nonirrigated): 3w **Typical profile** 0 to 9 inches: Silty clay loam 9 to 41 inches: Clay 41 to 60 inches: Channery clay loam **Minor Components Purdy** Percent of map unit: 5 percent Landform: Backswamps on stream terraces Landform position (two-dimensional): Toeslope Landform position (three-dimensional): Tread Down-slope shape: Concave Across-slope shape: Concave

Clarke County, Virginia - 30B—Nicholson-Duffield silt loams, 3 to 8 percent slopes: Map Unit Setting Elevation: 300 to 1,000 feet Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days **Map Unit Composition** Nicholson and similar soils: 50 percent Duffield and similar soils: 35 percent **Description of Nicholson Setting** Landform: Mountain slopes Landform position (two-dimensional): Summit Landform position (three-dimensional): Mountaintop 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: 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 18 to 30 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 4.7 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 10 inches: Silt loam 10 to 23 inches: Silt loam 23 to 36 inches: Silt loam 36 to 58 inches: Silty clay

Description of Duffield Setting Landform: Mountain slopes Landform position (two-dimensional): Summit Landform position (three-dimensional): Mountaintop 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: 48 to 99 inches to lithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 10.4 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 10 inches: Silt loam 10 to 65 inches: Silty clay loam 65 to 88 inches: Silt loam

Clarke County, Virginia - 33B—Pagebrook silty clay loam, 0 to 7 percent slopes: Map Unit Setting Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days Map Unit Composition Pagebrook and similar soils: 80 percent **Description of Pagebrook Setting** Landform: Mountain slopes Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Alluvium **Properties and qualities** Slope: 0 to 7 percent Depth to restrictive feature: 60 to 98 inches to lithic bedrock 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 24 to 48 inches Frequency of flooding: Frequent Frequency of ponding: None Available water capacity: Moderate (about 6.9 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 8 inches: Silty clay loam 8 to 26 inches: Clay 26 to 57 inches: Clay 57 to 92 inches: Clay 92 to 102 inches: Bedrock

Clarke County, Virginia - 35B—Poplimento silt loam, 3 to 8 percent slopes: Map Unit Setting Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days Map Unit Composition Poplimento and similar soils: 80 percent **Description of Poplimento Setting** Landform: Mountain slopes Landform position (two-dimensional): Summit Landform position (three-dimensional): Mountaintop 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: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.5 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 9 inches: Silt loam 9 to 36 inches: Clay 36 to 58 inches: Channery silty clay 58 to 73 inches: Very channery silty clay

Clarke County, Virginia - 35C—Poplimento silt loam, 8 to 15 percent slopes: Map Unit Setting Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days Map Unit Composition Poplimento and similar soils: 80 percent **Description of Poplimento Setting** Landform: Mountain slopes Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from limestone and shale **Properties and qualities** Slope: 8 to 15 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 (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.5 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical**

profile 0 to 9 inches: Silt loam 9 to 36 inches: Clay 36 to 58 inches: Channery silty clay 58 to 73 inches: Very channery silty clay

Clarke County, Virginia - 36C—Poplimento silt loam, rocky, 8 to 15 percent slopes: Map Unit Setting Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days Map Unit Composition Poplimento and similar soils: 75 percent **Description of Poplimento Setting** Landform: Mountain slopes Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from limestone and shale **Properties and qualities** Slope: 8 to 15 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 (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.5 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 9 inches: Silt loam 9 to 36 inches: Clay 36 to 58 inches: Channery silty clay 58 to 73 inches: Very channery silty clay

Clarke County, Virginia - 37B—Poplimento-Rock outcrop complex, 3 to 15 percent slopes: Map Unit Setting Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days **Map Unit Composition** Poplimento and similar soils: 55 percent Rock outcrop: 25 percent **Description of Poplimento Setting** Landform: Mountain slopes Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from limestone and shale **Properties and qualities** Slope: 3 to 15 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 (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.5 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 9 inches: Silt loam 9 to 36 inches: Clay 36 to 58 inches: Channery silty clay 58 to 73 inches: Very channery silty clay **Description of Rock Outcrop Properties and qualities** Slope: 3 to 15 percent Depth to restrictive feature: 0 inches to lithic bedrock Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) **Interpretive groups** Land capability (nonirrigated): 8s **Typical profile** 0 to 60 inches: Bedrock

Clarke County, Virginia - 38B—Poplimento-Webbtown complex, 3 to 8 percent slopes: Map Unit Setting Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days **Map Unit Composition** Poplimento and similar soils: 45 percent Webbtown and similar soils: 35 percent **Description of Poplimento Setting** Landform: Mountain slopes Landform position (two-dimensional): Summit Landform position (three-dimensional): Mountaintop 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: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.5 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 9 inches: Silt loam 9 to 36 inches: Clay 36 to 58 inches: Channery silty clay 58 to 73 inches: Very channery silty clay **Description of Webbtown Setting** Landform: Mountain slopes Landform position (two-dimensional): Summit Landform position (three-dimensional): Mountaintop 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 40 inches to lithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 4.2 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 8 inches: Channery silt loam 8 to 34 inches: Very channery silty clay loam 34 to 50 inches: Very channery silty clay 0 to 72 inches: Very channery silty clay

Clarke County, Virginia - 43C—Rock outcrop-Opequon complex, 3 to 45 percent slopes: Map Unit Setting Elevation: 400 to 3,000 feet Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days **Map Unit Composition** Rock outcrop: 55 percent Opequon and similar soils: 25 percent **Description of Rock Outcrop Setting** Landform: Mountain slopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Mountainflank Down-slope shape: Linear Across-slope shape: Convex **Properties and qualities** Slope: 3 to 45 percent Depth to restrictive feature: 0 inches to lithic bedrock Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr) **Interpretive groups** Land capability (nonirrigated): 8s **Typical profile** 0 to 60 inches: Bedrock **Description of Opequon Setting** Landform: Mountain slopes Landform position (two-dimensional): Summit, shoulder, backslope Landform position (three-dimensional): Mountainflank, mountaintop Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from limestone and shale **Properties and qualities** Slope: 3 to 45 percent Depth to restrictive feature: 17 to 21 inches to lithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 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 **Typical profile** 0 to 8 inches: Silty clay 8 to 17 inches: Clay 17 to 27 inches: Bedrock

Clarke County, Virginia - 51B—Timberville silt loam, 0 to 7 percent slopes: Map Unit Setting Elevation: 1,400 to 3,600 feet Mean annual precipitation: 32 to 43 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 152 to 198 days **Map Unit Composition** Timberville and similar soils: 80 percent **Description of Timberville Setting** Landform: Flood plains Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium **Properties and qualities** Slope: 0 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 high to high (0.57 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Frequent Frequency of ponding: None Available water capacity: Moderate (about 8.8 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 9 inches: Silt loam 9 to 31 inches: Silt loam 31 to 81 inches: 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 53). 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 53).

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 53), 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.

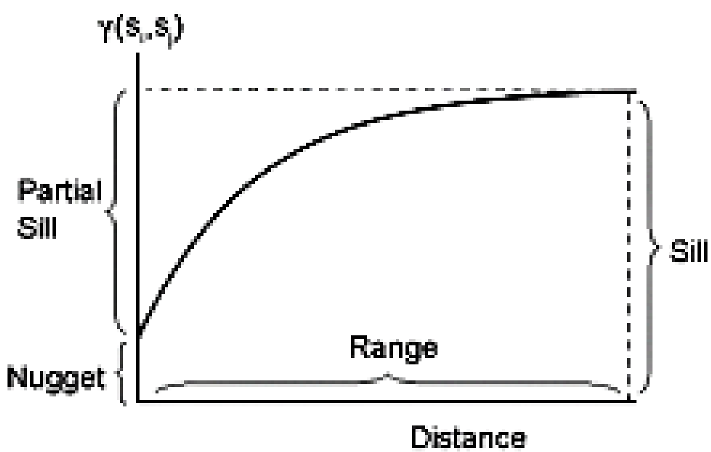


Figure 53. Example semivariogram, depicting range, sill, and nugget.

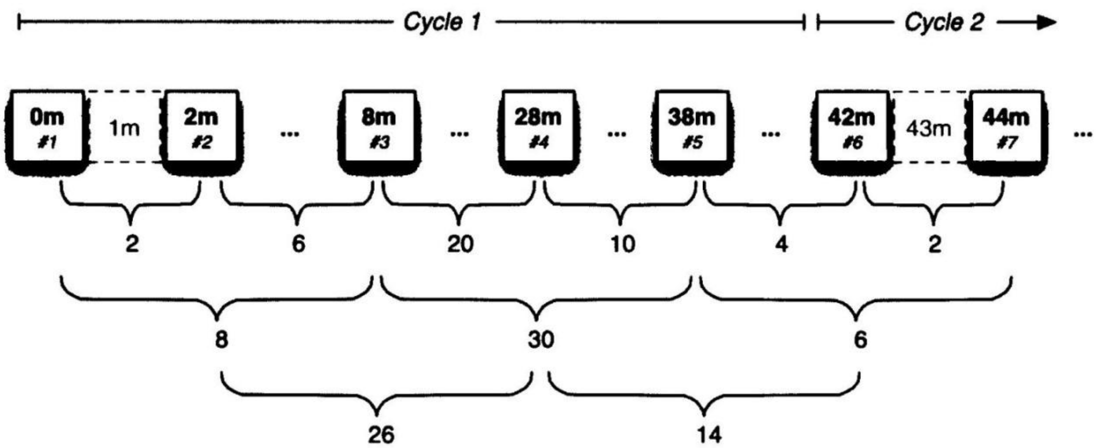


Figure 54. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 18 August 2010 at the Blandy site. The sampling points followed the spatially cyclic sampling design by Bond-Lamberty et al. (2006) (Figure 54). Soil temperature and moisture measurements were collected along three transects (168 m, 84 m, and 84 m) located in the expected airshed at Blandy. 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 54, 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 55). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 56, left graphs) and directional semivariograms do not show anisotropy (Figure 56, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 56, right graph). The model indicates a distance of effective independence of 103 m for soil temperature.

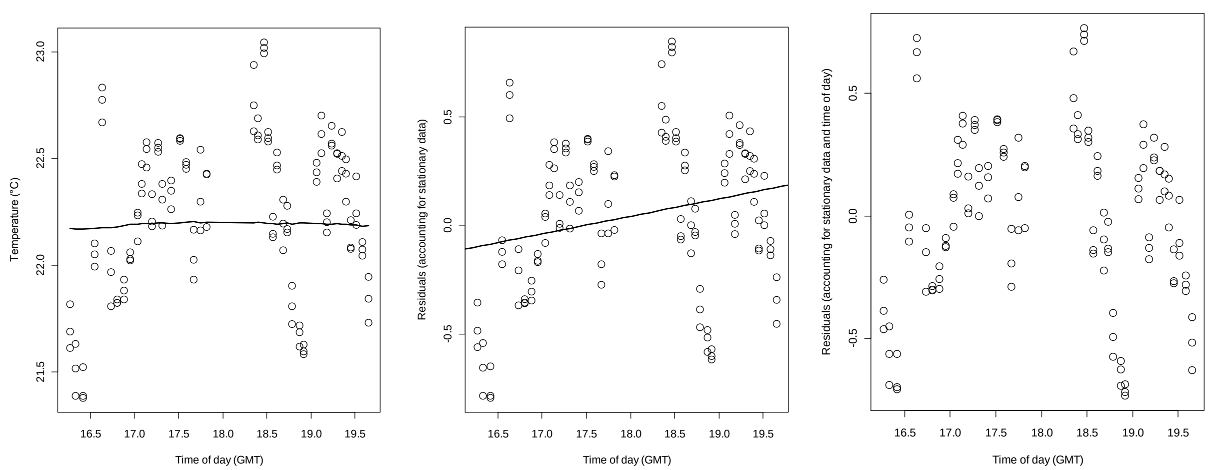


Figure 55. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting for changes temperature in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

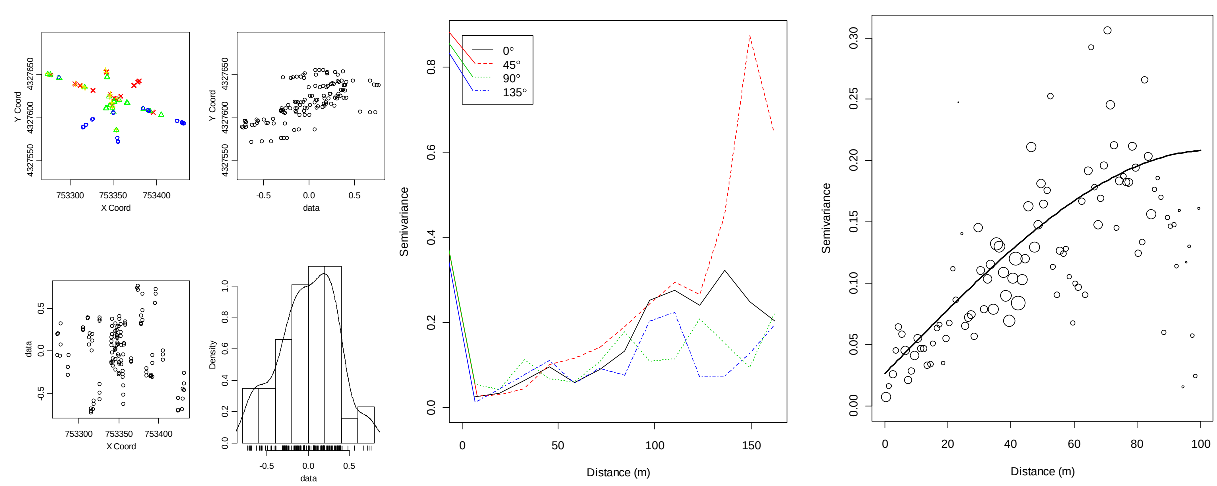


Figure 56. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

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 57). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 58, left graph) and directional semivariograms do not show anisotropy (Figure 58, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 58, right graph). The model indicates a distance of effective independence of 47 m for soil water content.

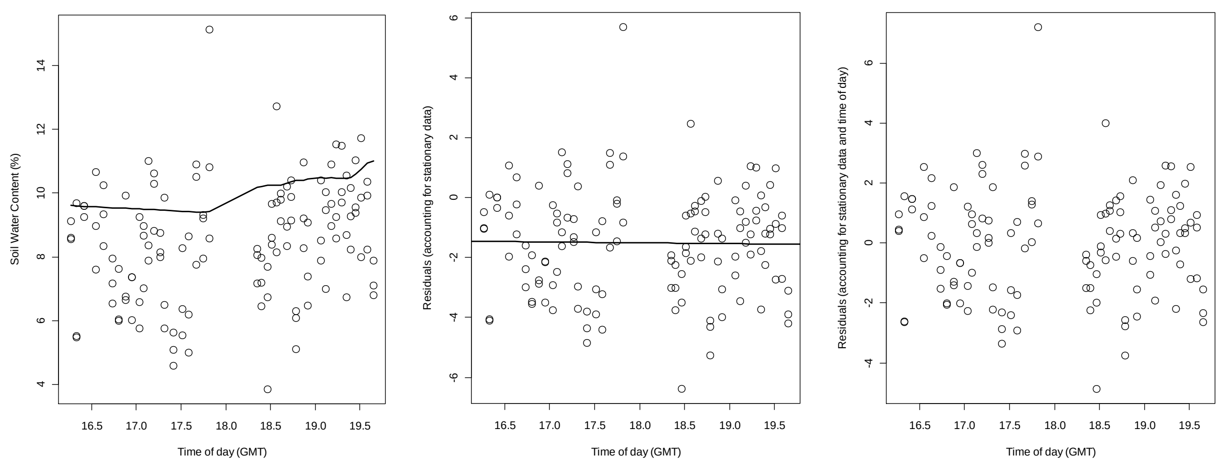


Figure 57. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting 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.

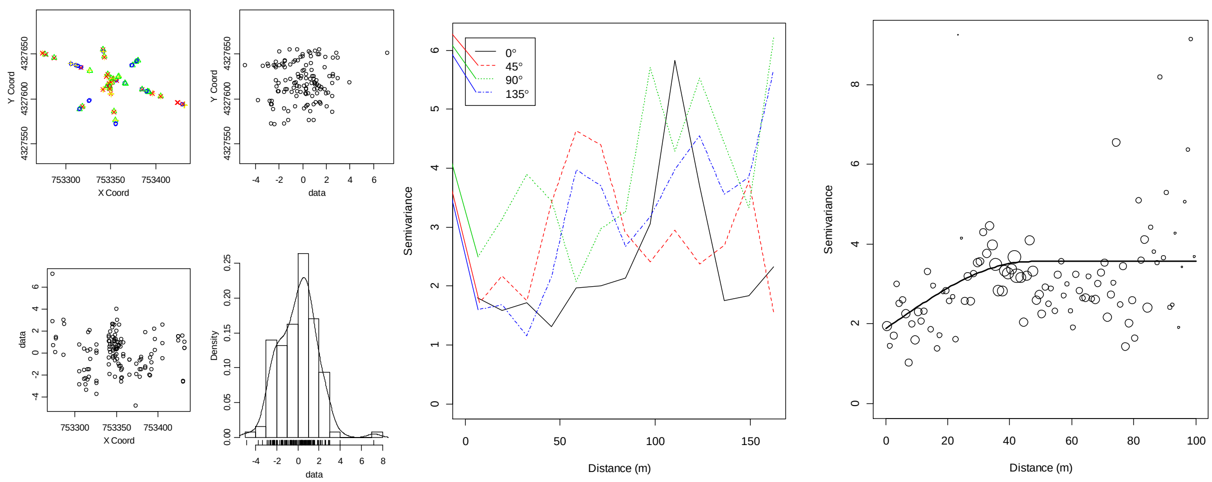


Figure 58. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

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 103 m for soil temperature and 47 m for soil moisture. Based on these results and the site design guidelines the soil plots at Blandy 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 300° from the soil plot nearest the tower (i.e., first soil plot). The location of the first soil plot will be approximately 39.060323°, -78.071794°. The exact location of each soil plot will be chosen by an FIU team member during site construction 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 39.06044, -78.07119 (primary location); or 39.06083, -78.07059 (alternate location 1 if primary location is unsuitable); or 39.06013, -78.07135 (alternate location 2 if primary location is unsuitable). A summary of the soil information is shown in Table 18 and site layout can be seen in Figure 59.

Dominant soil series at the site: Timberville silt loam, 0 to 7 percent slopes-Poplimento silt loam, 3 to 8 percent slopes-Nicholson-Duffield silt loams, 3 to 8 percent slopes. The taxonomy of this soil is shown below:
Order: Ultisols-Alfisols
Suborder: Udults-Udalfs
Great group: Hapludults-Hapludalfs-Fragiudalfs
Subgroup: Typic Hapludults-Ultic Hapludalfs-Oxyaquic Fragiudalfs
Family: Fine, mixed, active, mesic Typic Hapludults- Fine, mixed, subactive, mesic Ultic Hapludalfs -Fine-silty, mixed, active, mesic Oxyaquic Fragiudalfs-Fine-loamy, mixed, active, mesic Ultic Hapludalfs

Series: Timberville silt loam, 0 to 7 percent slopes-Poplimento silt loam, 3 to 8 percent slopes-Nicholson-Duffield silt loams, 3 to 8 percent slopes

Table 18. Summary of soil array and soil pit information at Blandy.
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	15 m
Latitude and longitude of 1st soil plot OR direction from tower	39.060323°, -78.071794°
Direction of soil array	300°
Latitude and longitude of FIU soil pit 1	39.06044, -78.07119 (primary location)
Latitude and longitude of FIU soil pit 2	39.06083, -78.07059 (alternate 1)
Latitude and longitude of FIU soil pit 3	39.06013, -78.07135 (alternate 2)
Dominant soil type	Timberville silt loam, 0 to 7 percent slopes-Poplimento silt loam, 3 to 8 percent slopes-Nicholson-Duffield silt loams, 3 to 8 percent slopes
Expected soil depth	1.22 - >2 m
Depth to water table	0.46 - >2 m

Expected depth of soil horizons	**Expected measurement depths****
0-0.23 m (Silt loam)*	0.12 m
0.23-0.58 m (Silt loam-Silty clay loam-Clay)*	0.41 m
0.58-0.91 m (Silt loam-Silty clay loam-Clay)*	0.75 m
0.91-2 m (Silty clay-Silt loam-Very channery silty clay-Clay)*	1.46 m

*Since there are many different soil types at this site, the number of soil horizons, and their depth, may differ substantially among the 5 soil plots

***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.

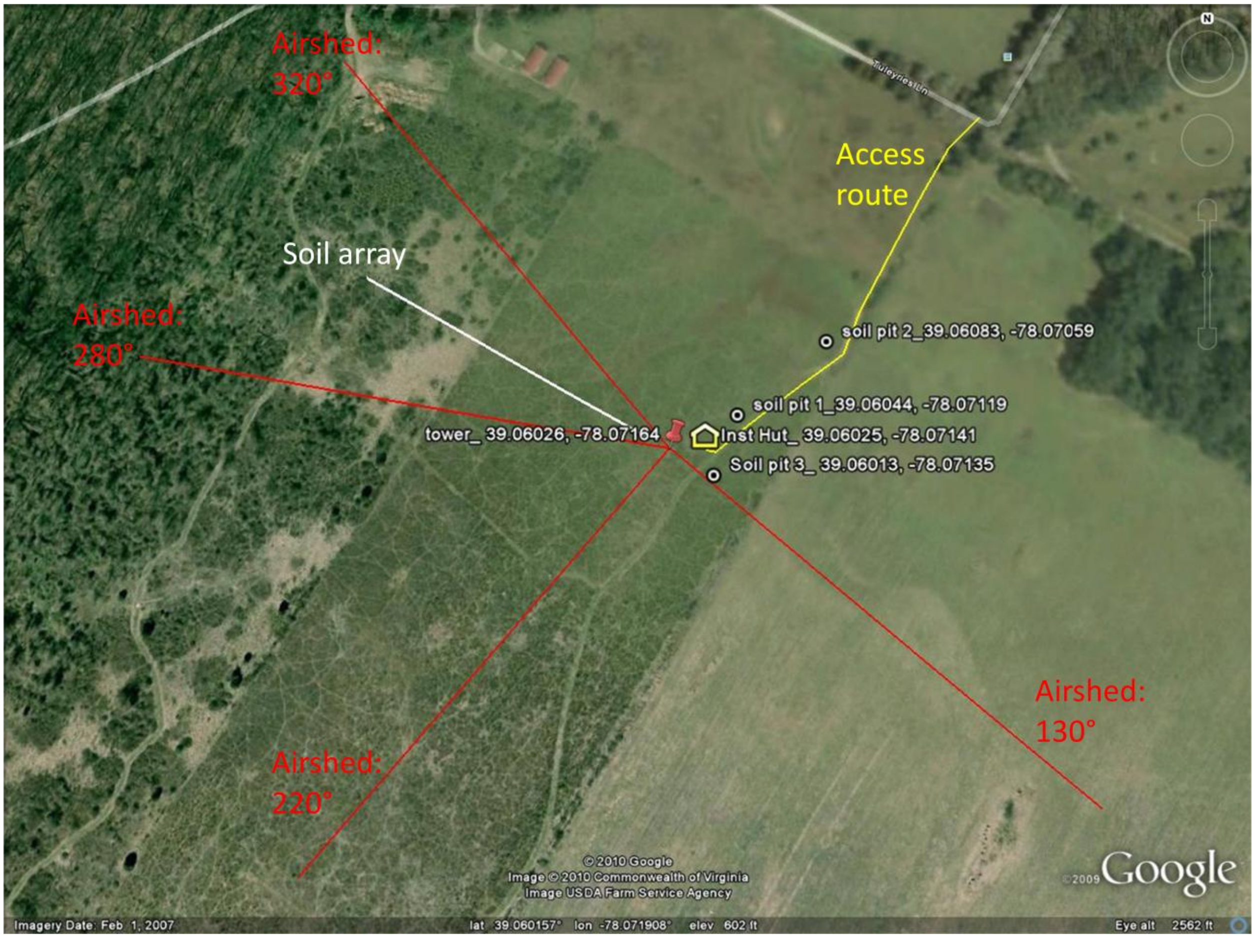


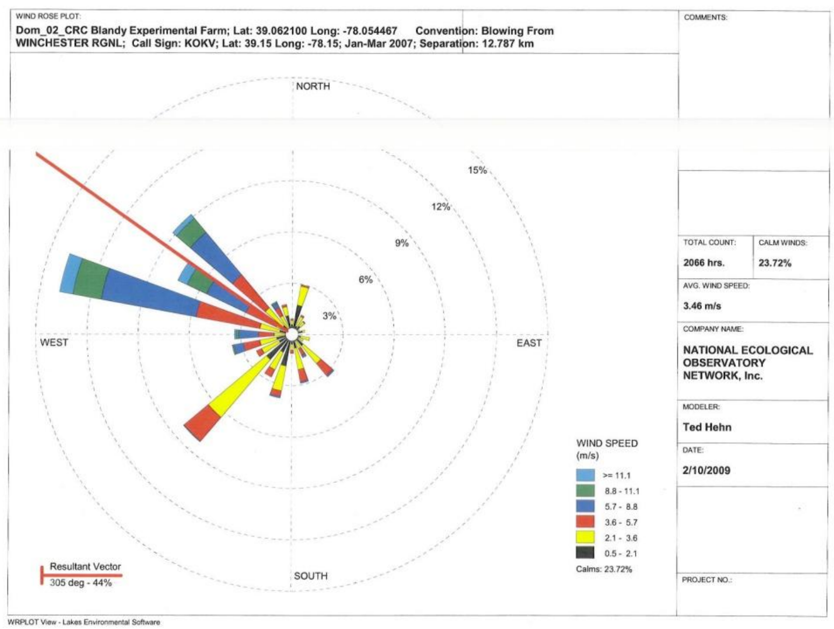
Figure 59. Site layout at Blandy showing soil array and location of the FIU soil pit.

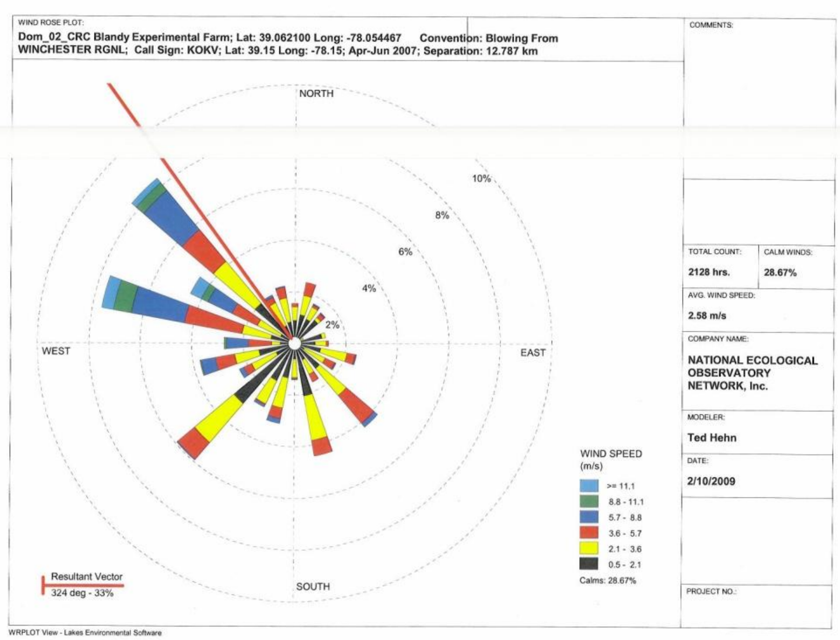
5.4 Airshed

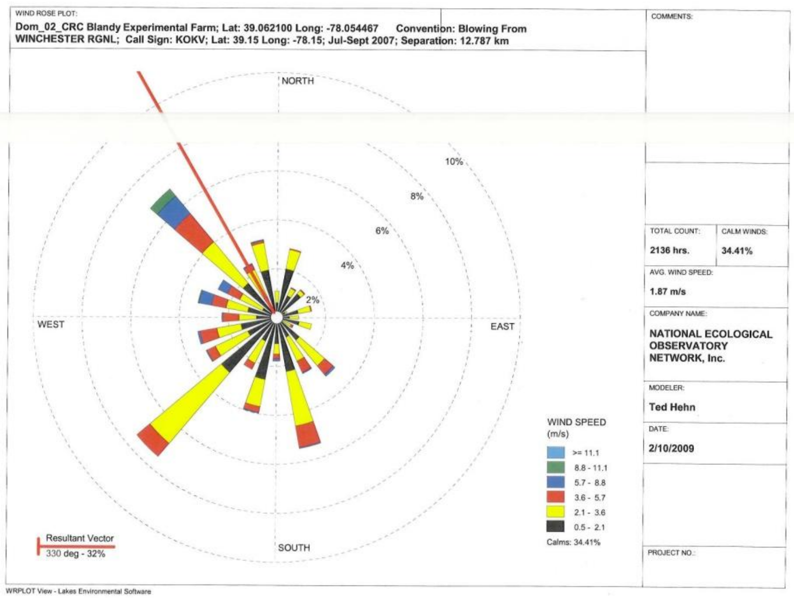
5.4.1 Seasonal windroses

Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given timeseries (Figures 60). Data used to generate windroses were 2007 data set from Winchester Regional Airport (39.15°, -78.15°), which is about 12.8 km away from NEON Blandy Farm Relocatable tower location. 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.

5.4.2 Results (graphs for wind roses)







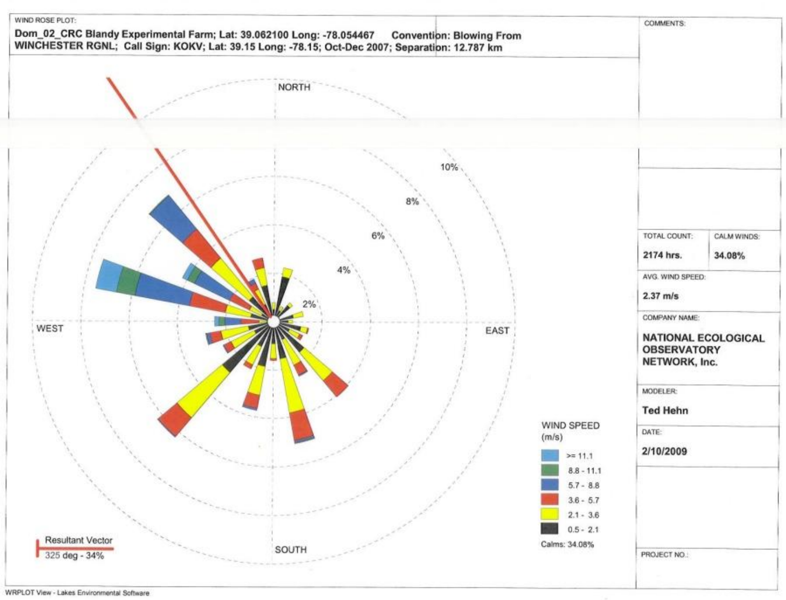


Figure 60. Windroses for Blandy Farm Relocatable tower site
Wind roses based on the data from Winchester Regional Airport (39.15^{o}, -78.15^{o}), Panels (from top to bottom) are from Jan-Mar, Apr-Jun, Jul-Sept, and Oct-Dec.

5.4.3 Resultant vectors

Table 20. The resultant wind vectors from Winchester Regional Airport using hourly data in 2007.

Quarterly (seasonal) timeperiod	Resultant vector	% duration
January to March	305°	44
April to June	324°	33
July to September	330°	32
October to December	325°	34
Annual mean	321°	na.

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 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 19. Expected environmental controls to parameterize the source area model based on the wind roses for Winchester Regional Airport, and associated results from Blandy Farm 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	6	6	6	6	6	6	m
Canopy Height	1.2	1.2	1.2	1.2	1.2	1.2	m
Canopy area density	1.5	1.5	1.5	0.5	0.5	0.5	m
Boundary layer depth	2000	2000	900	900	900	700	m
Expected sensible heat flux	450	450	-25	180	180	-76	W m^{-2}
Air Temperature	28	28	20	-1	-1	-3	°C
Max. windspeed	11.2	3.8	2.6	13	5.0	2.6	m s^{-1}
Resultant wind vector	316	316	216	284	284	216	degrees
(z-d)/L	-0.02	-0.37	0.23	-0.01	-0.08	3.00	m
d	1.00	1.00	1.00	0.78	0.78	0.78	m
Sigma v	2.70	1.90	1.80	2.80	1.50	1.60	m^2 s^{-2}
Z0	0.09	0.09	0.09	0.12	0.12	0.12	m
u*	1.10	0.43	0.20	1.30	0.54	0.06	m s^{-1}
Distance source area begins	0	0	0	0	0	250	m
Distance of 90% cumulative flux	650	300	1400	700	480	3250	m
Distance of 80% cumulative flux	400	200	750	400	300	2650	m
Distance of 70% cumulative flux	250	150	480	270	200	2250	m
Peak contribution	55	35	65	45	45	795	m

5.4.5 Results (source area graphs)

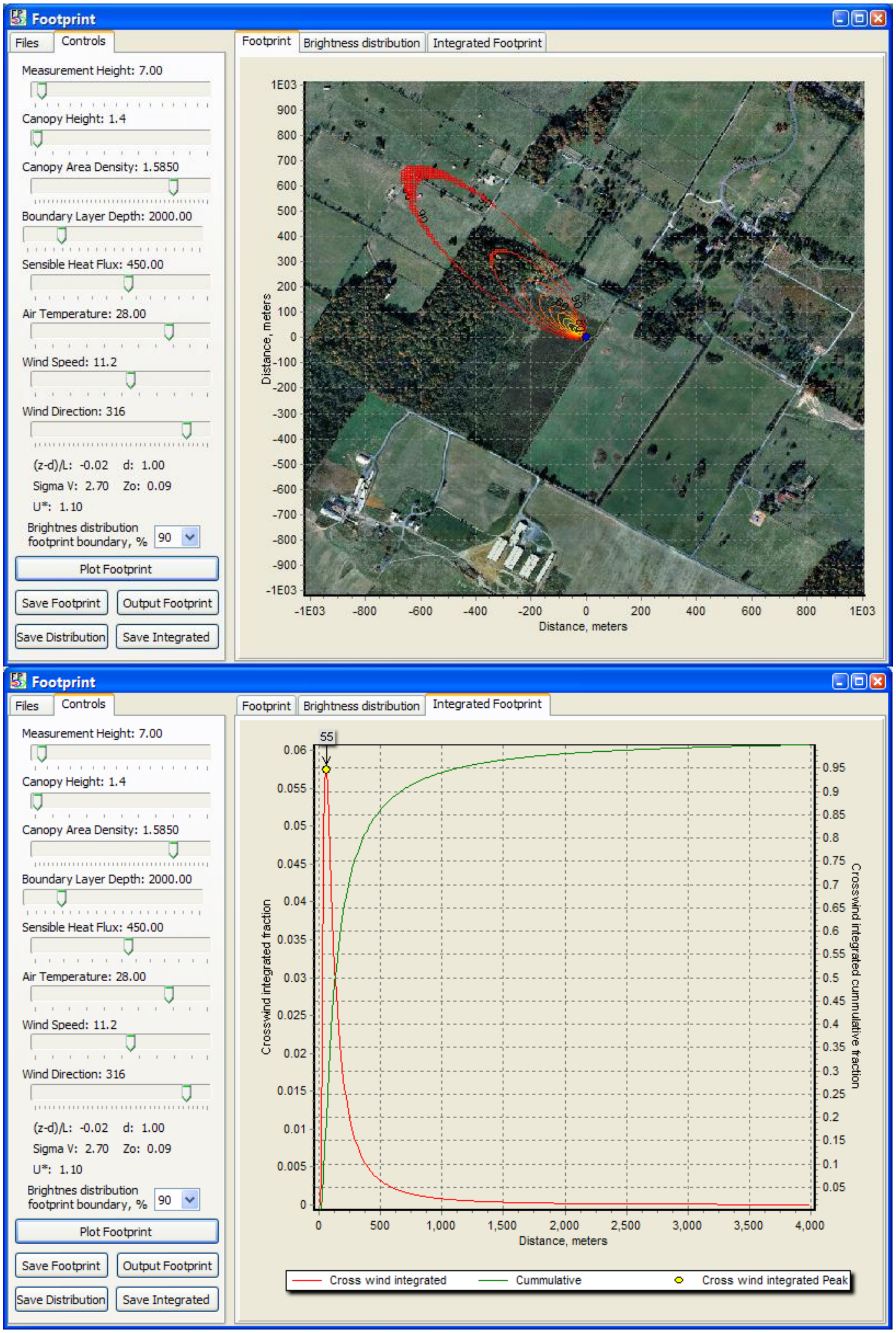


Figure 61. Blandy Farm summer daytime (convective) footprint output with max wind speed.

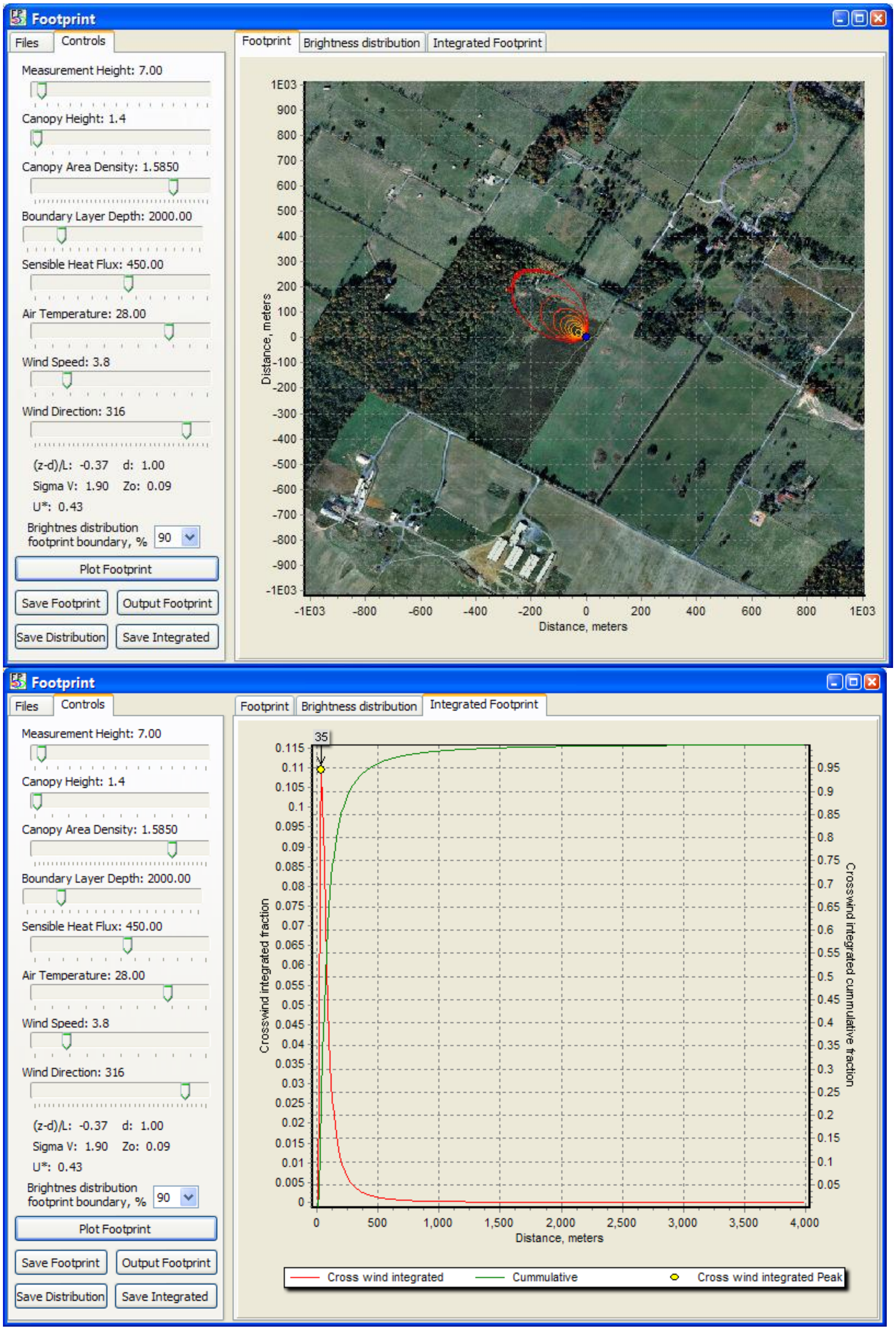


Figure 62. Blandy Farm summer daytime (convective) footprint output with mean wind speed.

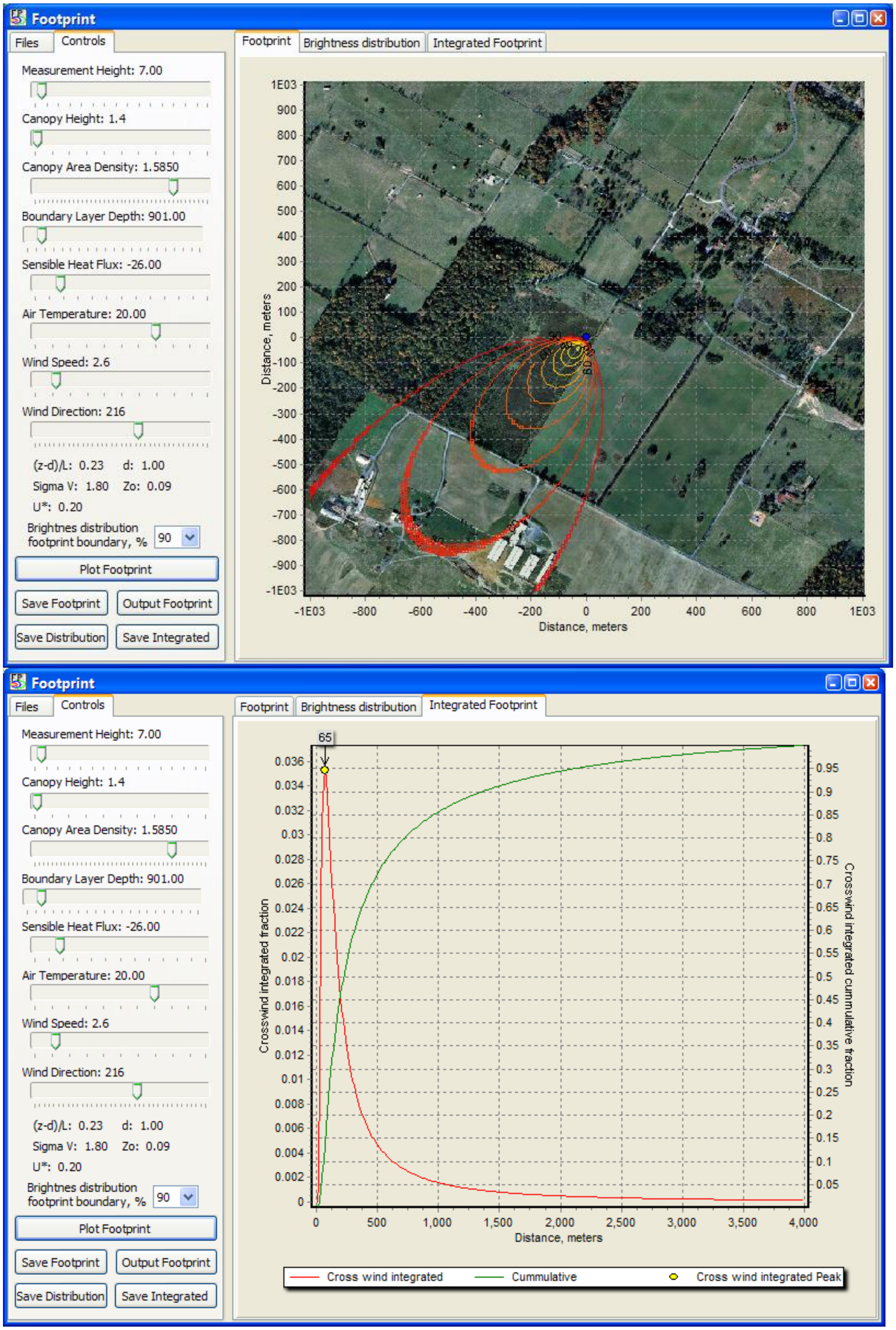


Figure 63. Blandy Farm summer nighttime (stable) footprint output with mean wind speed.

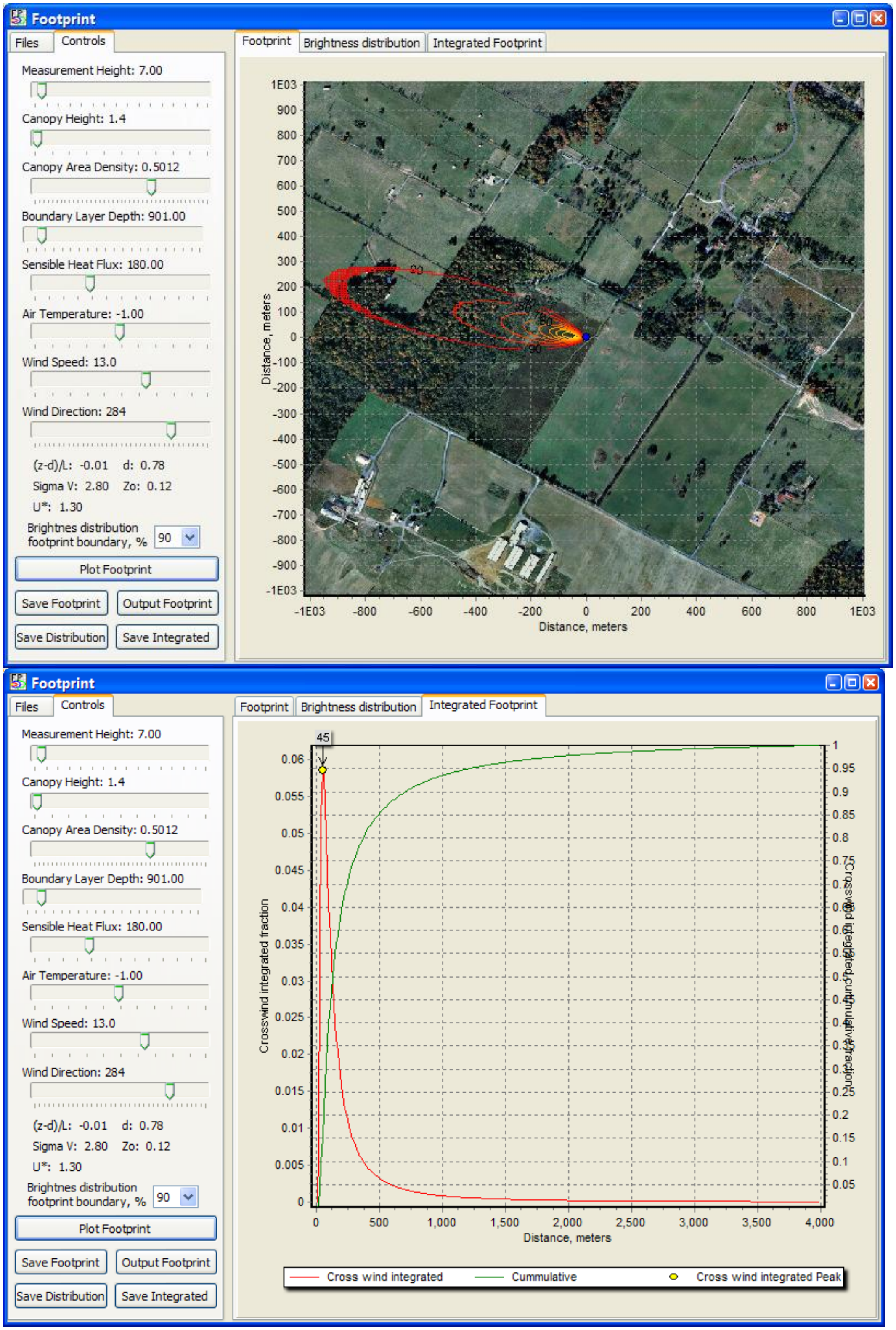


Figure 64. Blandy Farm winter daytime (convective) footprint output with max wind speed.

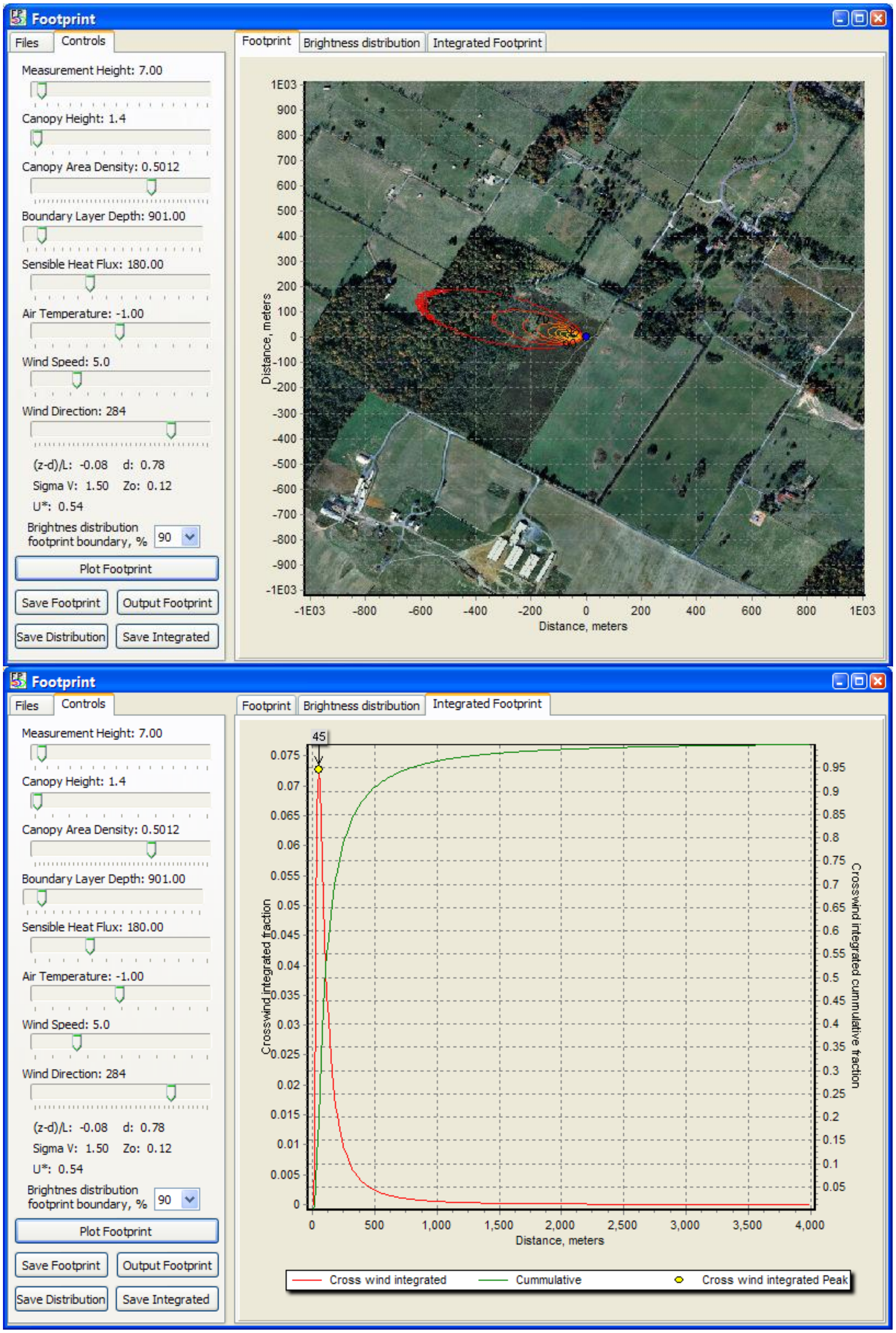


Figure 65. Blandy Farm winter daytime (convective) footprint output with mean wind speed.

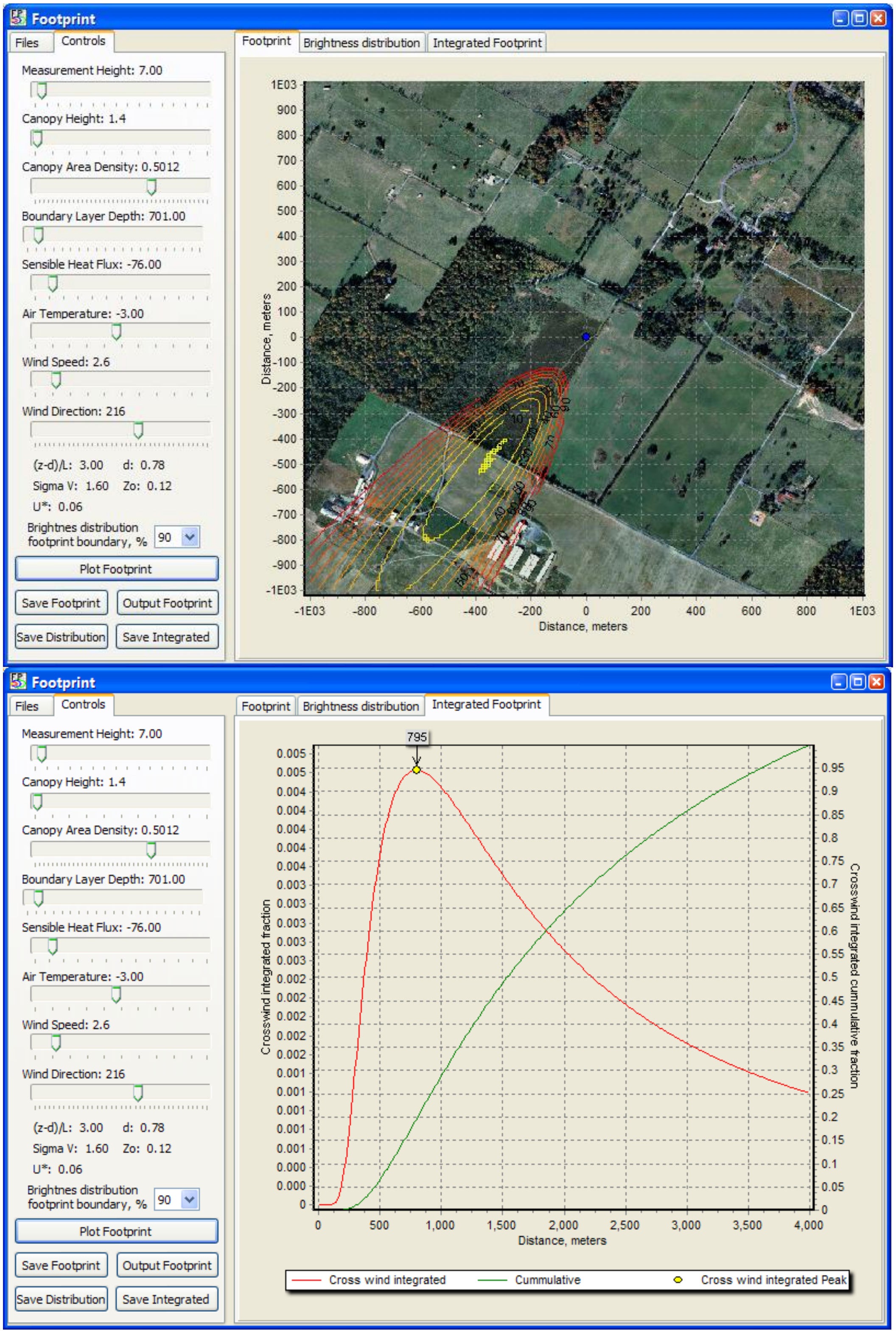


Figure 66. Blandy Farm winter nighttime (stable) footprint output with mean wind speed.

5.4.6 Site design and tower attributes

According to wind roses, the wind direction blows from northwest, and south throughout the whole year. The prevailing wind airshed for the tower is from 280^{o} to 320^{o} (clockwise from 280^{o}, major airshed), and from 130^{o} to 220^{o} (clockwise from 220^{o}, secondary airshed) throughout the whole year. The tower should be placed at a location to best catch the signals from the airshed of the ecosystem in interest, which is common buckthorn (*Rhamnus cathartica*) and goldenrod (*Solidago altissima*) in the abandoned old fields and hay/corn in the farm field. FIU determined that the tower location is 39.06026, -78.07164.

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 east toward tower and have the longer side parallel to NW-SE direction. We require the placement of instrument hut at 39.06025, -78.07141.

Canopy height is ~1.2 m (varies from 0.5 m to 2.5 m) around tower site with lowest branches at ground level at old field area. Canopy height is ~0.5 m for the hay farm land. No understory layers are present. We require 4 **measurement layers** on the tower with top measurement height at 6 m, and rest layers are 3 m, 1.2 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 at the top of tower at this site. **Wet deposition collector** will collocated at the top of the tower 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 20. Site design and tower attributes for Blandy Experimental Farm Relocatable 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			280^{o} to 320^{o} (major) 130^{o} to 220^{o} (secondary)		Clockwise from first angle

Tower location	39.06026°,	-78.07164°	--	--	new site
Instrument hut	39.06025°,	-78.07141°			
Instrument hut orientation vector	--	--	120º-300º		
Instrument hut distance z	--	--	--	19	
Anemometer/Temperature boom orientation	--	--	240°	--	
Height of the measurement levels					
Level 1				0.2	m.a.g.l.
Level 2				1.2	m.a.g.l.
Level 3				3.0	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.

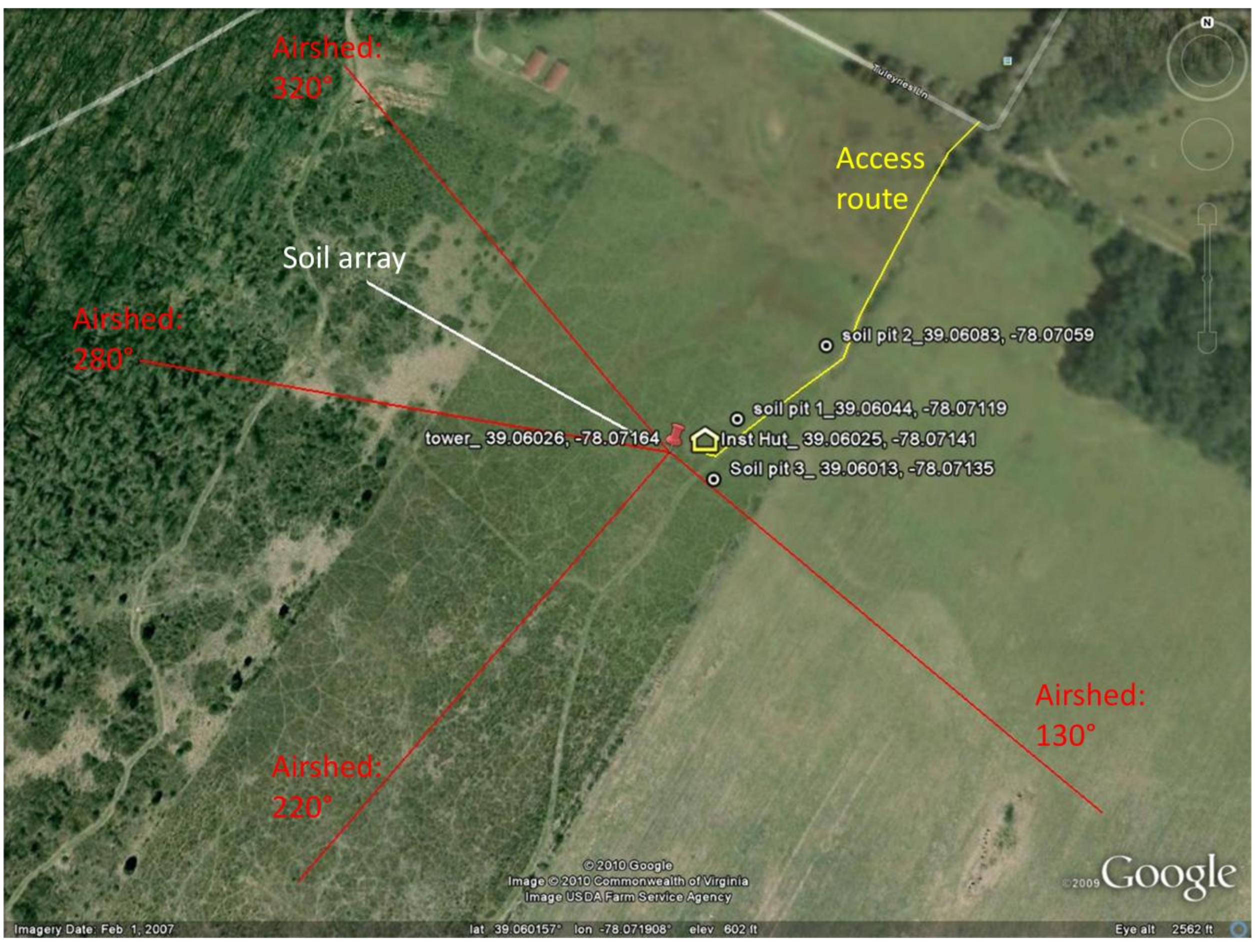


Figure 67. Site layout for Blandy Experimental Farm Relocatable site.

i) new tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 280^o to 320^o (clockwise from 280^o, major airshed), and from 130^o to 220^o (clockwise from 220^o, secondary airshed) 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. 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 the Blandy Experimental Farm Relocatable site

- Boardwalk is from the access dirt road to instrument hut, pending landowner decision
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- Boardwalk required 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:

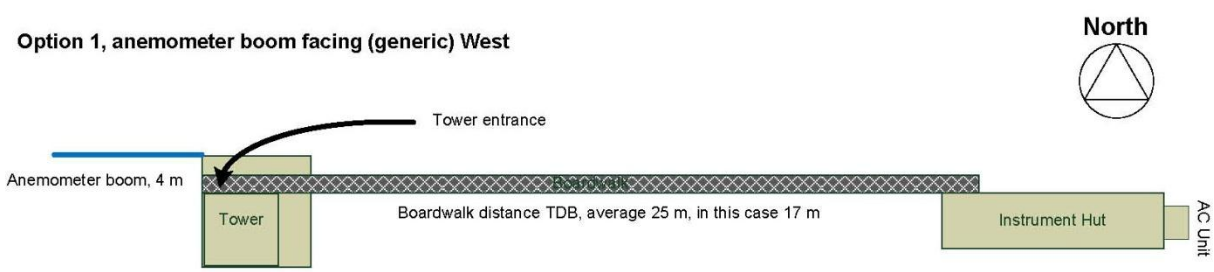


Figure 68. Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the east towards the tower.

This is just a generic diagram when boom facing west and instrument hut on the general east towards the tower. The actual design of boardwalk (or path if no boardwalk required) and instrument hut position will be the co-responsibility of FCC and FIU team. At this site, the boom angle will be 240 degrees, instrument hut will be on the east towards the tower, the distance between instrument hut and tower is ~19 m. The instrument hut vector will be SE-NW (120^o-300^o).

5.4.7 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 (common buckthorn (*Rhamnus cathartica*) and goldenrod (*Solidago altissima*) in the abandoned old fields and hays/corns in the farm field). Airshed at this site is from 280º to 320º (clockwise from 280º, major airshed) and from 130º to 220º (clockwise from 130º, secondary airshed) throughout the whole year. 90% daytime signals for flux measurements are within a distance of 700 m from tower, and 80% within 400 m. Therefore, we suggest FSU Ecosystem Productivity plots are placed within the major tower airshed boundaries of 280º to 320º (clockwise from 280º) for invasive species study, or within the secondary tower airshed boundaries of 130º to 220º (clockwise from 130º) for hay/corn study.

5.5 Issues and attentions

The tower site on EHS' list is 39.0621º, -78.05446667º. According to the wind roses and footprint analysis, the major fetch area for this tower site is from the experimental area, which contains 20 plots at different ecosystem succession stages as results of plowing at different frequencies. This will make it difficult to interpret the flux signals from this area due to the fragment surface. After FIU site characterization, tower location was miscrosited to 39.06026°, 78.07164° in abandoned old fields. Goldenrod (*Solidago altissima,* in more recent abandon farm field) and shrub common buckthorn (*Rhamnus cathartica,* in older abandoned farm field) are dominant vegetation in the major airshed on northwest to tower location (280º to 320º, clockwise from 280º). Invasive species is common in this area. Common buckthorn (*Rhamnus cathartica*) is the dominant invasive plants in this field, although there is some disagreement about the species identification (per personal communication with Dr David Carr). FIU measurements can be tied to the FSU study about invasive species here. The dominant ecosystem type in the secondary airshed on the south to the tower location is hay or corn, depending on farmers' decision. Although ideally we wish to have a homogenous surface in the tower airshed for flux measurements, two ecosystems in our airshed will have less uncertainty than 20 different plots when interpreting flux signals. However, how to separate signals from different ecosystems, how to interpret the measurement results, and how to quantify the uncertainties remains a challenge.

Tower location in the abandon field has gotten the ok from the Blandy Farm director Dr David Carr. According to Kyle Jonathan Haynes (Associate Director), the farmland is currently leased to farmer, and can be taken back if NEON or other research projects need it. If possible, we would suggest Blandy Farm take the farmland back so that NEON's science will be less impacted by the unforeseen consequences during the measurement period.

There is an existing 10-m antenna tower southwest ~80 m to NEON tower location. It is on the edge of our secondary airshed. No large impact is foreseen on NEON measurements. No active measurements were observed on the tower during FIU site visit. Dr David Carr will check with the tower operator and get back us if he/she has any concerns.

We do not see any major logistic issues at this site. Power line is <100 m from tower location. Access road is next to tower location and instrument hut location.

6 REFERENCES:

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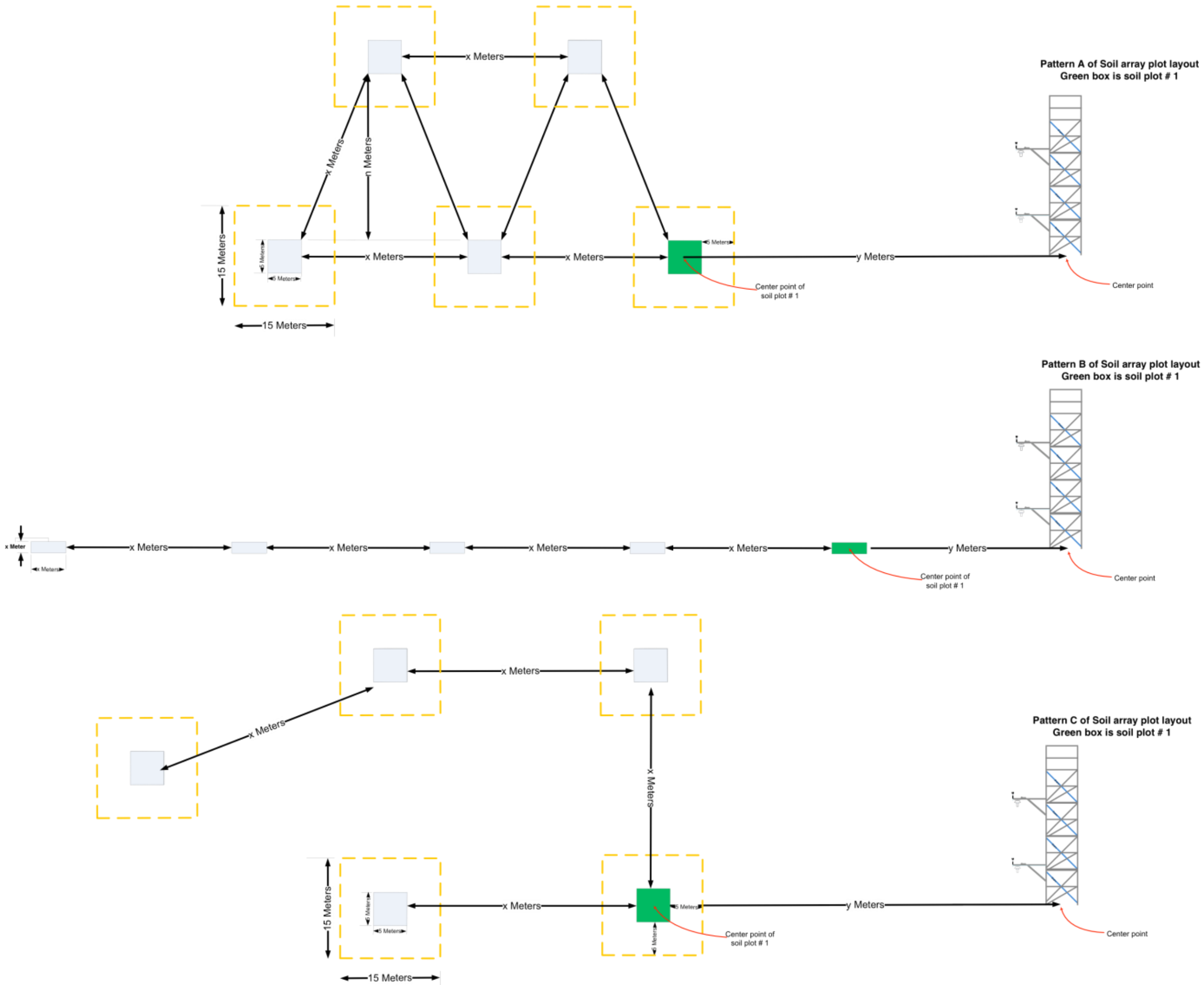
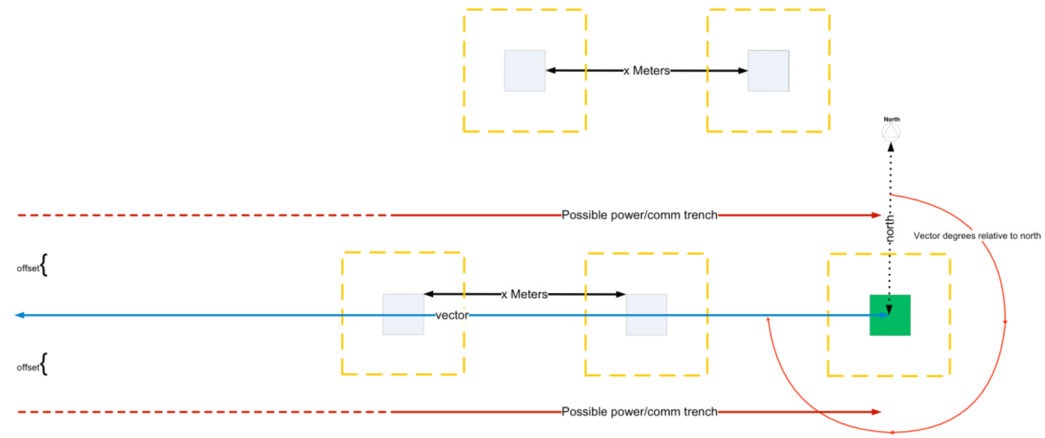
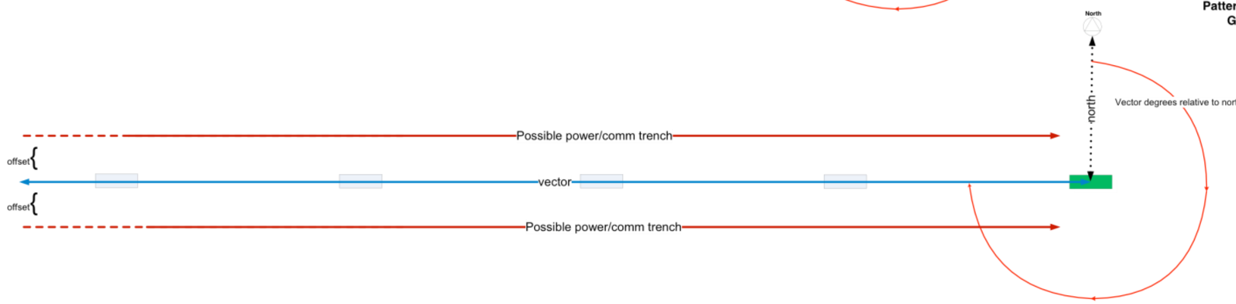
7 APPENDIX A. OPTIONAL SOIL ARRAY PATTERNS.

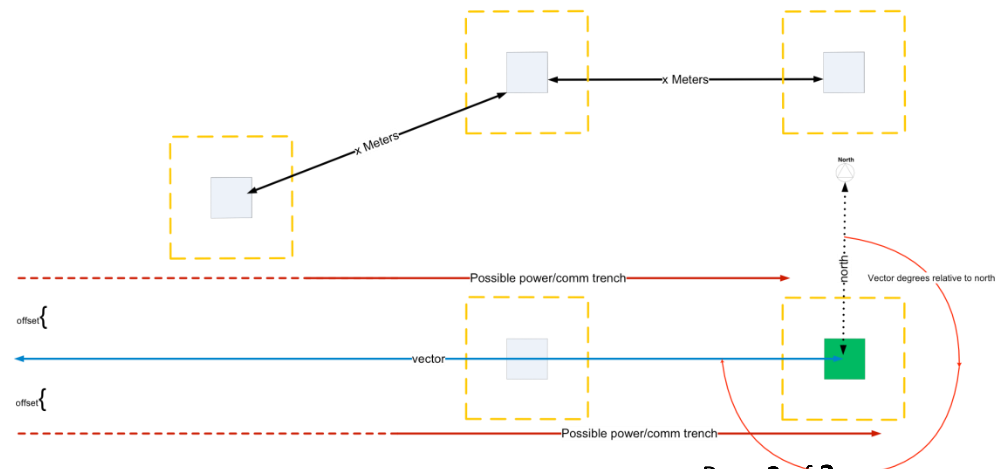




Pattern A of Soil array plot layout
Green box is soil plot # 1



Pattern B of Soil array plot layout
Green box is soil plot # 1



Pattern C of Soil array plot layout
Green box is soil plot # 1

Figure A1. Conceptual diagram of Soil Array Patterns

Outlines the orientation for the soil array and instrument hut from the center point of the tower. The x, y, z distances are i) the distance between soil plots, ii) distance between the tower centerpoint and the closest edge of soil plot, and iii) the distance between the tower centerpoint and the closest edge of the instrument hut, respectively. The yellow outline around each soil plot is the 5 m perimeter keep out zone.