D03 FIU Site Characterization Supporting Data

PREPARED BY	ORGANIZATION	DATE
Ed Ayres	FIU	12/10/2010
Hongyan Luo	FIU	12/10/2010

APPROVALS (Name)	ORGANIZATION	APPROVAL DATE
Hank Loescher	FIU	10/06/2011

RELEASED BY (Name)	ORGANIZATION	RELEASE DATE
Anne Balsley	CCB ADMINISTRATOR/DCS	10/06/2011

See Configuration Management System for approval history

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
1.0	5/14/2010		INITIAL DRAFT
A	6/22/2010	NEON.FIU.000242.CRE	CCB APPROVED INITIAL RELEASE
B	9/16/2010	NEON.FIU.000246.CRE	UPDATES SEE CRE
C	12/10/2010	NEON.FIU.000274.CRE	UPDATES SEE CRE
D	09/23/2011	ECO-00279	Update to new document number's/template throughout document.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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 03. This document presents all the supporting data for FIU site characterization.

1.2 Scope

FIU site characterization data presented in this document are for the three D03 tower locations: Ordway-Swisher Biological Station site (Advanced), Disney Wilderness Preserve site (Relocatable 1), and Jones Ecological Research Center site (Relocatable 2).

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

AD[01]	
AD[02]	
AD[03]	
AD[04]	

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 ORDWAY-SWISHER (ADVANCED TOWER SITE)

3.1 Site Description

The NEON advanced tower site at the Ordway-Swisher Biological Station (OSBS) is located in Putnam County, north Florida (Figure 1). The original tower site was lat 29.68998591°, long -81.99353439°, after FIU site characterization, we determine the exact tower location to be at 29.68927°, -81.99343° to minimize the needs for tree cutting during tower construction. New location is about 80 m south of original tower location and closer to access road.

The OSBS site is characterized by flat to gently rolling topography, with low topographic relief. The highest and lowest point at the site is 55.5 m and 24 m, respectively. Typical of the region, OSBS has numerous shallow lakes and ponds interspersed among the hills. Average annual temperature at the OSBS is 20°C and mean annual precipitation is 1320 mm, most of which typically falls between June and September. Annual precipitation patterns at the site are highly variable and periods of below average precipitation (drought) are not uncommon. The site is also subject to hurricanes and tropical storms. Both hurricane landfall and severe droughts occur about every 15 years on average, with the latter often leading to severe wildfire conditions.

Human occupancy of OSBS extends back to prehistorical Native American use and has included mixed farming, forestry, and recreational use at various times over the last ~170 years. Current land use around OSBS is a mix of rural residential, agriculture, mining, and forestry. Long-term monitoring efforts at OSBS have focused on meteorology, limnology, vegetation succession, and species abundance and population trends for the purpose of supplementing research and conservation efforts.

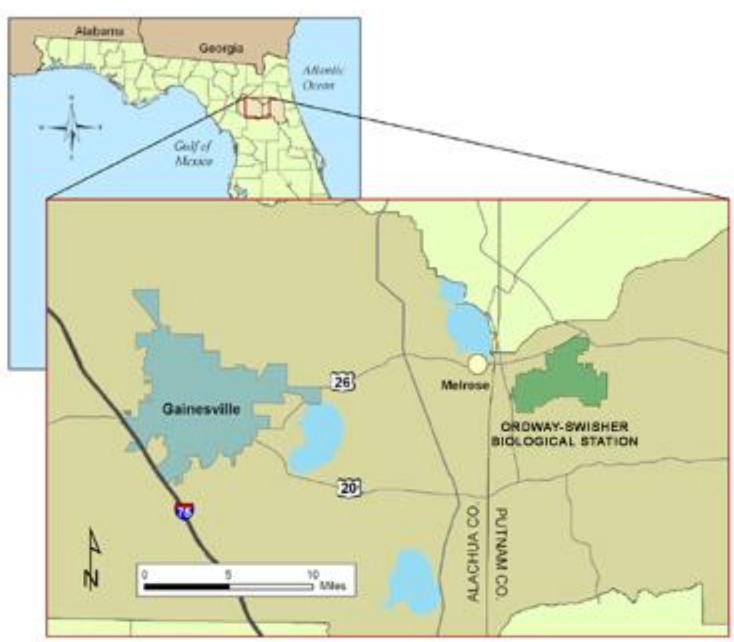


Figure 1. Location of the Ordway site.

3.1.1 Ecosystem

The OSBS site is a mid-sized natural upland pine/hardwood site set in a mixed land use matrix. The dominant habitat type at the OSBS is longleaf pine sandhill and mean canopy height in the area is between 10 m and 25 m. The major upland soils at the OSBS are excessively drained to well-drained sandy soils with a depth up to 24 m. Plant and animal species lists at OSBS can be found at http://ordway-swisher.ufl.edu/species/index.htm.

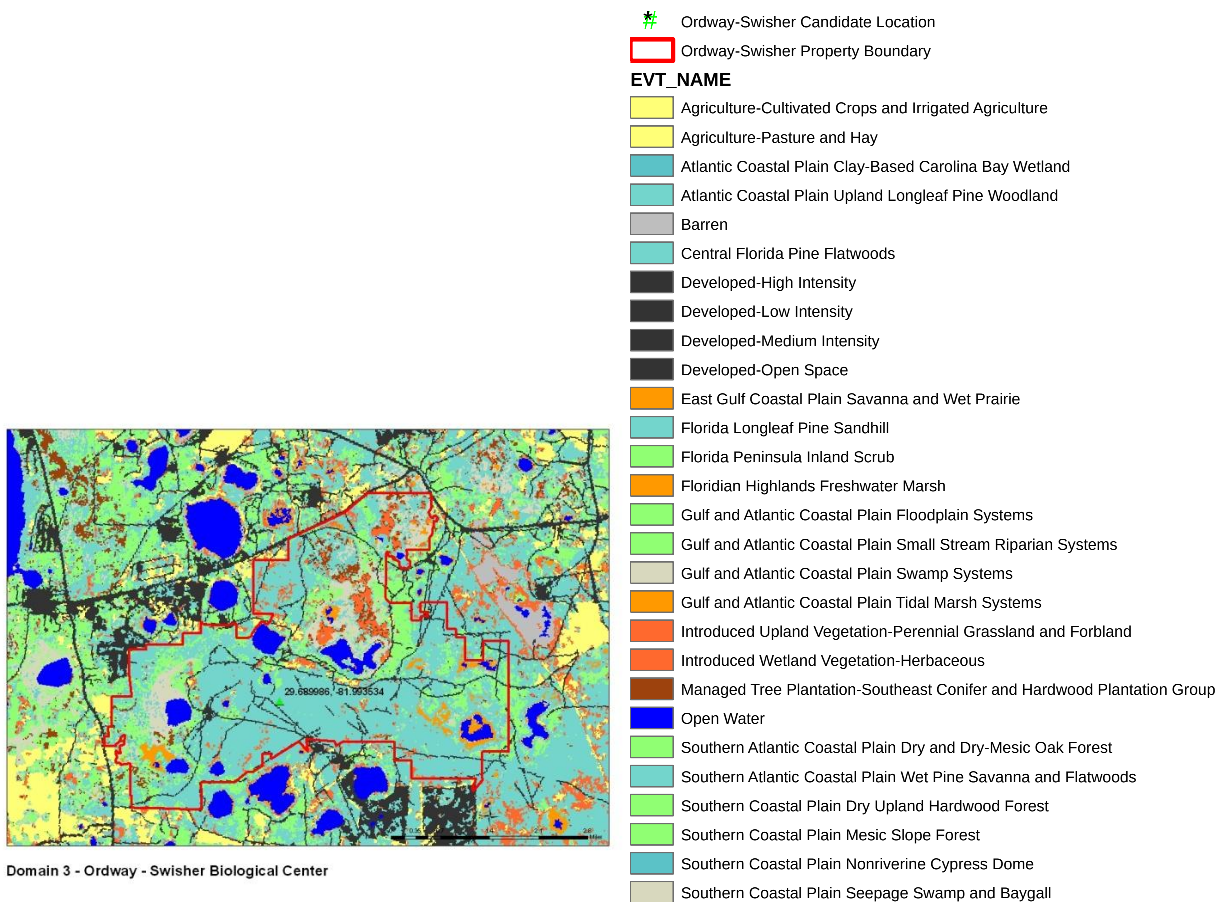


Figure 2. Vegetation map for Ordway-Swisher and surrounding area (information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm).

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

Veg_Type	Area (km^2)	%
Agriculture-Cultivated Crops and Irrigated Agriculture	0.02	0.06
Agriculture-Pasture and Hay	0.23	0.63
Atlantic Coastal Plain Clay-Based Carolina Bay Wetland	0.03	0.09
Central Florida Pine Flatwoods	3.96	10.76
Developed-Low Intensity	0.01	0.03
Developed-Open Space	2.06	5.60
Florida Longleaf Pine Sandhill	16.09	43.72
Florida Peninsula Inland Scrub	0.02	0.05
Floridian Highlands Freshwater Marsh	1.10	2.98
Gulf and Atlantic Coastal Plain Floodplain Systems	0.03	0.07
Gulf and Atlantic Coastal Plain Small Stream Riparian Systems	0.97	2.63
Gulf and Atlantic Coastal Plain Swamp Systems	2.88	7.83
Gulf and Atlantic Coastal Plain Tidal Marsh Systems	0.04	0.12
Introduced Upland Vegetation-Perennial Grassland and Forbland	1.79	4.86
Introduced Wetland Vegetation-Herbaceous	0.01	0.03
Managed Tree Plantation-Southeast Conifer and Hardwood Plantation Group	1.03	2.80
Open Water	1.74	4.72
Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods	0.04	0.11
Southern Coastal Plain Dry Upland Hardwood Forest	4.11	11.16
Southern Coastal Plain Mesic Slope Forest	0.01	0.02
Southern Coastal Plain Nonriverine Cypress Dome	0.14	0.38
Southern Coastal Plain Seepage Swamp and Baygall	0.50	1.36
Total Area Sq Km	**36.81**	**100.00**

The ecosystem in the NEON tower fetch area is open forest dominant by mature longleaf pine (and co-dominant with Turkey Oak), with average canopy height ~15 m and projected ground coverage ~50%. Tall trees on top layer around tower can reach ~23 m. **This is a fire-dominated system with controlled burns.** Recruitment and establishment of pine seedlings are spatially patchy. Their heights vary with average canopy height ~11 m. Besides young pine seedlings, understory includes oak recruited seedlings after prescribed fire and wiregrasses. Oak seedlings are ~1.2 m and wiregrass is ~0.35 m tall. The stem of oak seedling is thin (< 1" in diameter). Controlled burns are managed with a 2-4 years fire frequency to manage the deciduous understory composition and native biodiversity. Wiregrass covers ground patchily in the tower fetch area (< 60% ground coverage).

The ecosystem attributes to this site are summarized as following:
Table 2. Ecosystem and site attributes for the Ordway site.

Ecosystem attributes	Measure and units
Mean canopy height	23 m
Surface roughness[a]	1.7 m
Zero place displacement height[a]	19.5 m
Structural elements	Open pine forest canopy, uniform
Altitude[b]	25-55 [m] a.s.l.
Slope	0%
Aspect	0
Time zone	Atlantic
Magnetic declination	5° 28' W
Frost-free period	365 days

Note, [a] From field survey.
[b] From field survey and best estimate. Forest is very open.

3.2 Soils

3.2.1 Soil Description

Soil data and soil maps (Figures 3) below for Ordway-Swisher Advanced tower site were collected from 2.4 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.

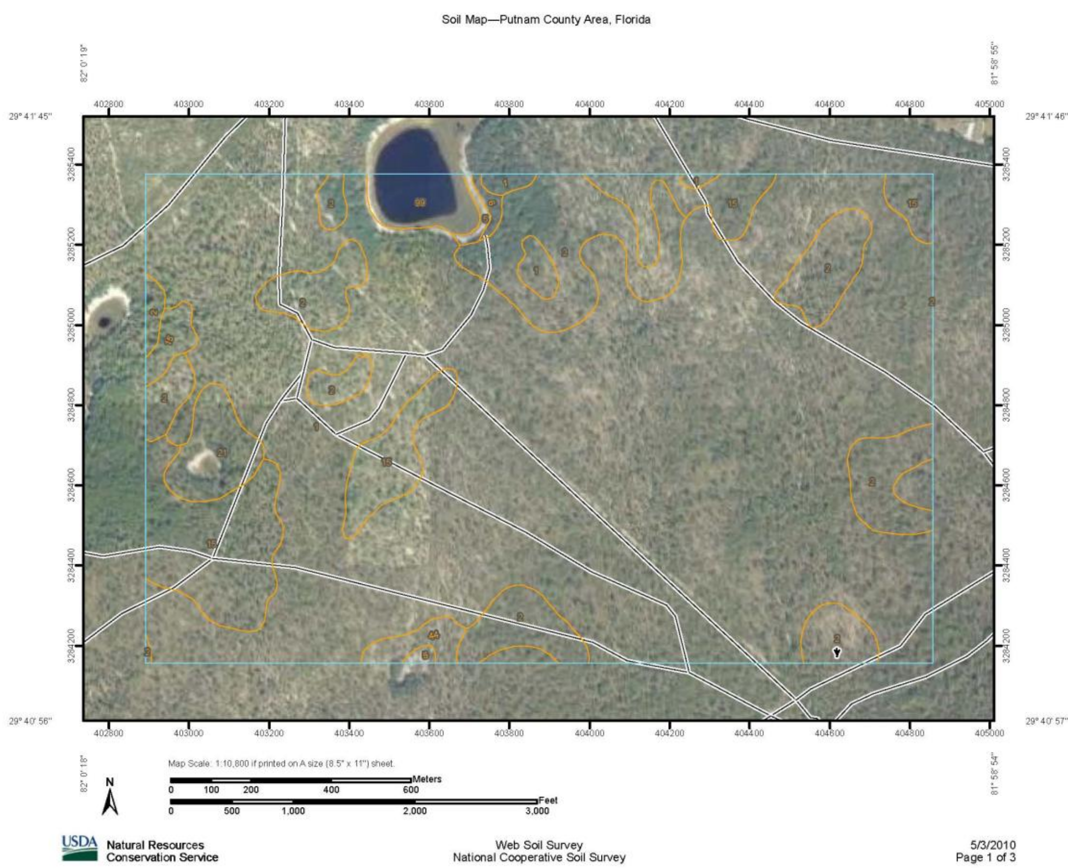


Figure 3. 2.4 km^2 soil map for Ordway-Swisher NEON advanced tower site, center at tower location.

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 2.4 km^2 centered on the tower. Area Object Interest (AOI) is the mapping unit from NRCS

Putnam County Area, Florida (FL107)			
Map Unit Symbol	**Soil types**	**Acres in AOI**	**% AOI**
1	Candler fine sand, 0 to 5 percent slopes	394.8	*71.0%
2	Candler fine sand, 5 to 8 percent slopes	70.0	*12.7%
5	Placid fine sand, depressional	1.7	0.3%
6	Tavares fine sand, 0 to 5 percent slopes	2.0	0.4%
15	Apopka sand, 0 to 5 percent slopes	62.8	*11.3%
21	Apopka sand, 5 to 8 percent slopes	10.9	2.0%
44	Candler sand, 12 to 25 percent slopes	4.2	0.70%
99	Water	13.0	2.3%
Totals for Area of Interest		592.7	100.0%

Note, asterisk indicates dominant soil type(s) in airshed

Putnam County Area, Florida (FL107)- Apopka sand, 0 to 5 percent slopes: Map Unit Setting Elevation: 0 to 350 feet Mean annual precipitation: 46 to 54 inches Mean annual air temperature: 68 to 75 degrees F Frost-free period: 304 to 334 days **Map Unit Composition** Apopka and similar soils: 75 percent Minor components: 25 percent **Description of Apopka Setting** Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Eolian deposits and/or sandy and loamy marine deposits **Properties and qualities** Slope: 0 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 (0.57 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Low (about 4.3 inches) **Interpretive groups** Land capability (nonirrigated): 3s Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Typical profile** 0 to 7 inches: Sand 7 to 43 inches: Sand 43 to 80 inches: Sandy clay loam **Minor Components Bonneau** Percent of map unit: 7 percent Landform: Knolls on marine terraces, ridges on marine terraces Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Convex Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Candler** Percent of map unit: 6 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Convex Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Millhopper** Percent of map unit: 6 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Sparr** Percent of map unit: 6 percent Landform: Rises on marine terraces, flats on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL)

Putnam County Area, Florida (FL107)- Apopka sand, 5 to 8 percent slopes: Map Unit Setting Elevation: 40 to 350 feet Mean annual precipitation: 46 to 54 inches Mean annual air temperature: 68 to 75 degrees F Frost-free period: 304 to 334 days **Map Unit Composition** Apopka and similar soils: 90 percent

Minor components: 10 percent **Description of Apopka Setting** Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Eolian deposits and/or sandy and loamy marine deposits **Properties and qualities** Slope: 5 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 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 Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Very low (about 2.9 inches) **Interpretive groups** Land capability (nonirrigated): 4s Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Typical profile** 0 to 7 inches: Sand 7 to 55 inches: Sand 55 to 80 inches: Sandy clay loam **Minor Components Candler** Percent of map unit: 3 percent Landform: Knolls on marine terraces, ridges on marine terraces Landform position (three-dimensional): Interfluve, side slope Down-slope shape: Convex Across-slope shape: Convex Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Bonneau** Percent of map unit: 3 percent Landform: Knolls on marine terraces, ridges on marine terraces Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Convex Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Sparr** Percent of map unit: 2 percent Landform: Rises on marine terraces, flats on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Millhopper** Percent of map unit: 2 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL)

Putnam County Area, Florida (FL107)- Candler fine sand, 0 to 5 percent slopes: Map Unit Setting Elevation: 20 to 150 feet Mean annual precipitation: 46 to 54 inches Mean annual air temperature: 68 to 75 degrees F Frost-free period: 304 to 334 days **Map Unit Composition** Candler and similar soils: 85 percent Minor components: 15 percent **Description of Candler Setting** Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Convex Parent material: Eolian deposits and/or sandy and loamy marine deposits **Properties and qualities** Slope: 0 to 5 percent Depth to restrictive feature: More than 80 inches Drainage class: Excessively drained Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Very low (about 2.5 inches) **Interpretive groups** Land capability (nonirrigated): 4s Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Typical profile** 0 to 4 inches: Fine sand 4 to 61 inches: Fine sand 61 to 80 inches: Fine sand **Minor Components Deland** Percent of map unit: 3 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Millhopper** Percent of map unit: 3 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Tavares** Percent of map unit: 3 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Apopka** Percent of map unit: 3 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Side slope, interfluves Down-slope shape:

Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Astatula** Percent of map unit: 3 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, side slope Down-slope shape: Convex Across-slope shape: Convex Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL)

Putnam County Area, Florida (FL107)- Candler fine sand, 5 to 8 percent slopes: Map Unit Setting Elevation: 20 to 150 feet Mean annual precipitation: 46 to 54 inches Mean annual air temperature: 68 to 75 degrees F Frost-free period: 304 to 334 days **Map Unit Composition** Candler and similar soils: 90 percent Minor components: 10 percent **Description of Candler Setting** Landform: Knolls on marine terraces, ridges on marine terraces Landform position (three-dimensional): Side slope, interfluves Down-slope shape: Convex Across-slope shape: Convex Parent material: Eolian deposits and/or sandy and loamy marine deposits **Properties and qualities** Slope: 5 to 8 percent Depth to restrictive feature: More than 80 inches Drainage class: Excessively drained Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Very low (about 2.5 inches) **Interpretive groups** Land capability (nonirrigated): 6s Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Typical profile** 0 to 4 inches: Fine sand 4 to 65 inches: Fine sand 65 to 80 inches: Fine sand **Minor Components Apopka** Percent of map unit: 3 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, side slope Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Astatula** Percent of map unit: 3 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, side slope Down-slope shape: Convex Across-slope shape: Convex Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Millhopper** Percent of map unit: 2 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Tavares** Percent of map unit: 2 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL)

Putnam County Area, Florida: 44—Candler sand, 12 to 25 percent slopes. Map Unit Setting *Elevation:* 20 to 150 feet *Mean annual precipitation:* 46 to 54 inches *Mean annual air temperature:* 68 to 75 degrees F *Frost-free period:* 304 to 334 days **Map Unit Composition** *Candler and similar soils:* 90 percent *Minor components:* 10 percent **Description of Candler Setting** *Landform:* Hills on marine terraces, hillslopes on marine terraces *Landform position (three-dimensional):* Side slope *Down-slope shape:* Convex *Across-slope shape:* Convex *Parent material:* Eolian deposits and/or sandy and loamy marine deposits **Properties and qualities** *Slope:* 12 to 25 percent *Depth to restrictive feature:* More than 80 inches *Drainage class:* Excessively drained *Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr) *Depth to water table:* More than 80 inches *Frequency of flooding:* None *Frequency of ponding:* None *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm) *Sodium adsorption ratio, maximum:* 4.0 *Available water capacity:* Very low (about 2.5 inches) **Interpretive groups** *Land capability (nonirrigated):* 7s *Ecological site:* Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Typical profile** *0 to 4 inches:* Sand *4 to 70 inches:* Sand *70 to 80 inches:* Sand **Minor Components Astatula** *Percent of map unit:* 3 percent *Landform:* Ridges on marine terraces, knolls on marine terraces *Landform position (three-dimensional):* Side slope *Down-slope shape:* Convex *Across-slope shape:*

Convex *Ecological site:* Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Apopka** *Percent of map unit:* 3 percent *Landform:* Ridges on marine terraces, knolls on marine terraces *Landform position (three-dimensional):* Interfluve, side slope *Down-slope shape:* Convex *Across-slope shape:* Linear *Ecological site:* Upland Hardwood Hammocks (R154XY008FL) **Tavares** *Percent of map unit:* 2 percent *Landform:* Ridges on marine terraces, knolls on marine terraces *Landform position (three-dimensional):* Interfluve, rise *Down-slope shape:* Convex *Across-slope shape:* Linear *Ecological site:* Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Millhopper** *Percent of map unit:* 2 percent *Landform:* Ridges on marine terraces, knolls on marine terraces *Landform position (three-dimensional):* Interfluve, rise *Down-slope shape:* Convex *Across-slope shape:* Linear *Ecological site:* Upland Hardwood Hammocks (R154XY008FL)

Putnam County Area, Florida (FL107)- Placid fine sand, depressional: Map Unit Setting Mean annual precipitation: 46 to 54 inches Mean annual air temperature: 68 to 75 degrees F Frost-free period: 304 to 334 days **Map Unit Composition** Placid, depressional, and similar soils: 90 percent Minor components: 10 percent **Description of Placid, Depressional Setting** Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave Parent material: Sandy marine deposits **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Very poorly drained Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr) Depth to water table: About 0 to 12 inches Frequency of flooding: None Frequency of ponding: Frequent Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Low (about 5.7 inches) **Interpretive groups** Land capability (nonirrigated): 7w Ecological site: Freshwater Marshes and Ponds (R154XY010FL) **Typical profile** 0 to 14 inches: Fine sand 14 to 80 inches: Fine sand **Minor Components Myakka, depressional** Percent of map unit: 3 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Ona, hydric** Percent of map unit: 3 percent Landform: Flats on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave Ecological site: North Florida Flatwoods (R154XY004FL) **St. johns, depressional** Percent of map unit: 2 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Samsula** Percent of map unit: 2 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave Ecological site: Freshwater Marshes and Ponds (R154XY010FL)

Putnam County Area, Florida (FL107)- Tavares fine sand, 0 to 5 percent slopes: Map Unit Setting Elevation: 10 to 150 feet Mean annual precipitation: 46 to 54 inches Mean annual air temperature: 68 to 75 degrees F Frost-free period: 304 to 334 days **Map Unit Composition** Tavares and similar soils: 80 percent Minor components: 20 percent **Description of Tavares Setting** Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Parent material: Eolian or sandy marine deposits **Properties and qualities** Slope: 0 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): High to very high (5.95 to 19.98 in/hr) Depth to water table: About 42 to 72 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Very low (about 2.6 inches) **Interpretive groups** Land capability (nonirrigated): 3s Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Typical profile** 0 to 5 inches: Fine sand 5 to 80 inches: Fine sand **Minor Components Candler** Percent of map unit: 4 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Convex Ecological site: Longleaf Pine-Turkey Oak Hills (R154XY002FL) **Adamsville** Percent of map unit: 4 percent Landform: Rises on marine terraces, flats on marine terraces Landform position (three-dimensional): Interfluve, rise, talf Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Zolfo** Percent of map unit: 3 percent Landform: Rises on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: North Florida Flatwoods (R154XY004FL) **Centenary** Percent of map unit: 3 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Narcoossee** Percent of map unit: 3 percent Landform: Rises on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL) **Sparr** Percent of map unit: 3 percent Landform: Rises on marine terraces, flats on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Ecological site: Upland Hardwood Hammocks (R154XY008FL)

Putnam County Area, Florida (FL107)-Water: Map Unit Composition Water: 100 percent

3.2.2 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 4). 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 4).

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 4), 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.

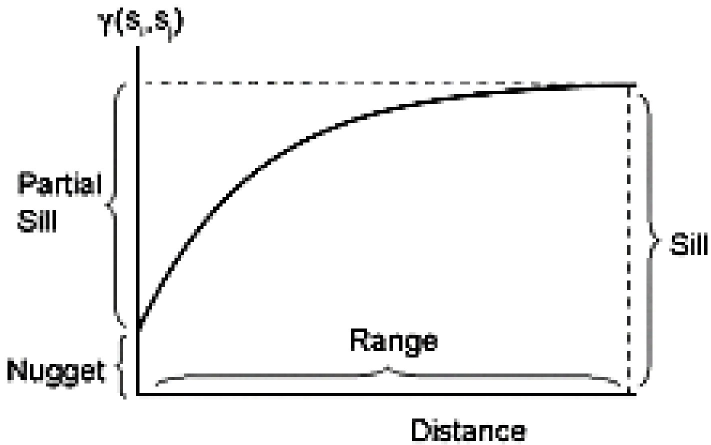


Figure 4. Example semivariogram, depicting range, sill, and nugget.

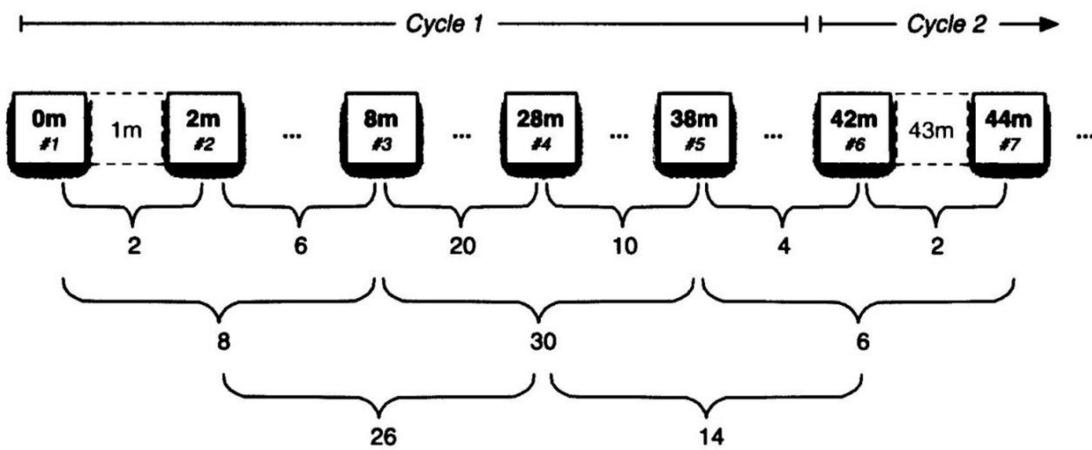


Figure 5. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 24 March 2010 at the Ordway-Swisher site. The sampling points followed the spatially cyclic sampling design by Bond-Lamberty et al. (2006) (Figure 5). Soil temperature and moisture measurements were collected along three transects (210 m, 84 m, and 84 m) located in the expected airshed at Ordway-Swisher. 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 5, 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 trend was still apparent in the data even after subtracting the stationary data from the mobile data. This trend was corrected for by fitting a linear regression based on time of day and elevation 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).

3.2.3 Results and interpretation

3.2.3.1 Soil Temperature

Soil temperature data residuals, after accounting for changes in temperature in the stationary data and any remaining time of day and elevation trend, were used for the semivariogram analysis (Figure 6). Exploratory data analysis plots show that there is no distinct patterning of the residuals (Figure 7, left graphs) and directional semivariograms do not show any indication of anisotropy (Figure 7, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 7, right graph). The model indicates a distance of effective independence of 6 m for soil temperature.

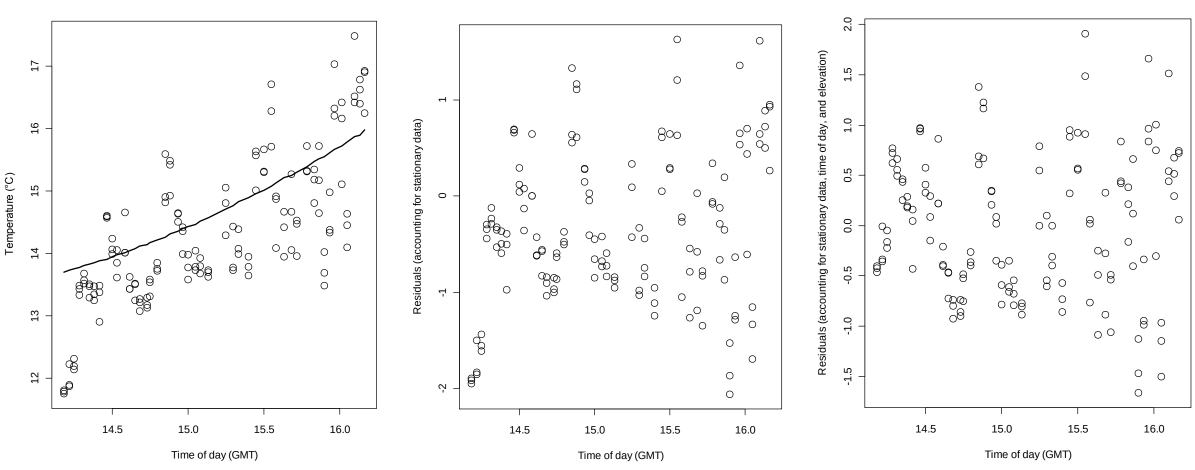


Figure 6. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting for changes temperature in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

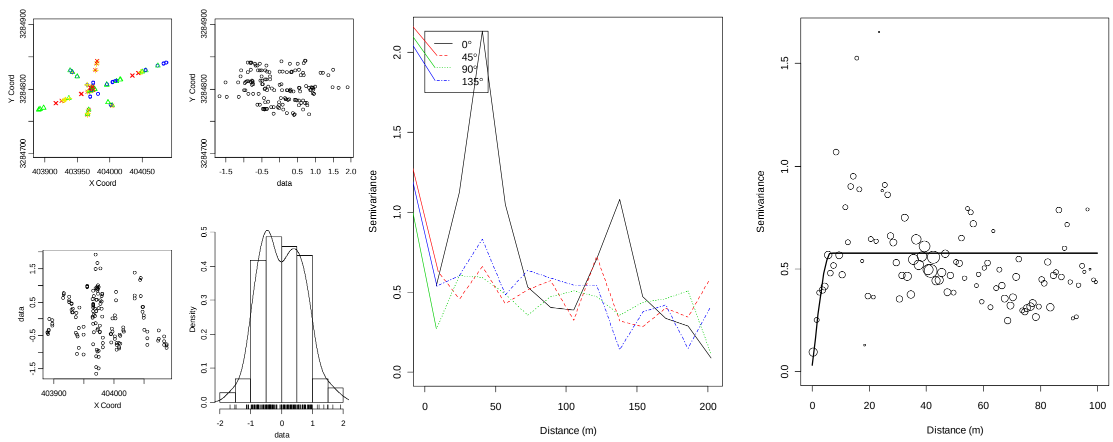


Figure 7. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

3.2.3.2 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 8). Exploratory data analysis plots show that there is no distinct patterning of the residuals (Figure 9, left graph) and directional semivariograms do not show any indication of anisotropy (Figure 9, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 9, right graph). The model indicates a distance of effective independence of 23 m for soil water content.

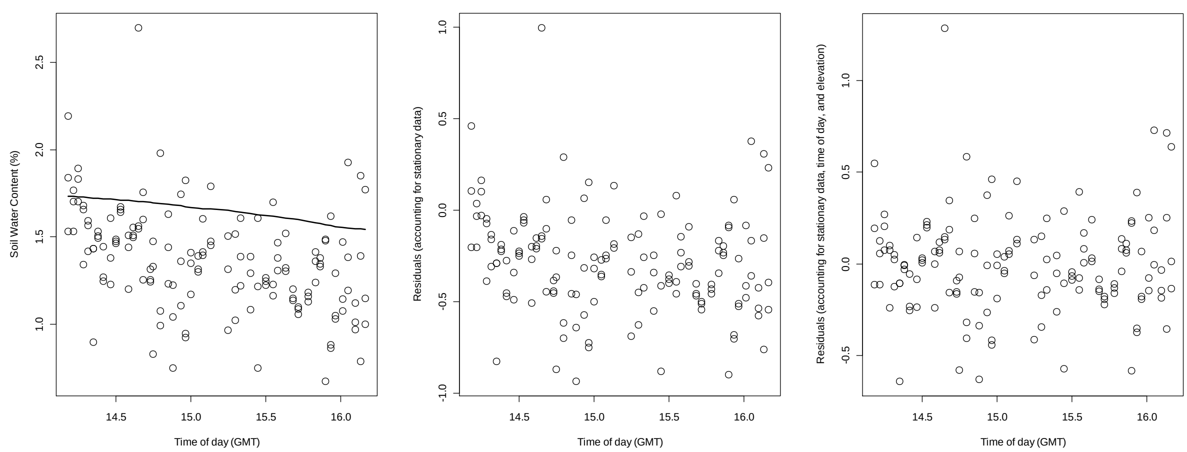


Figure 8. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting 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.

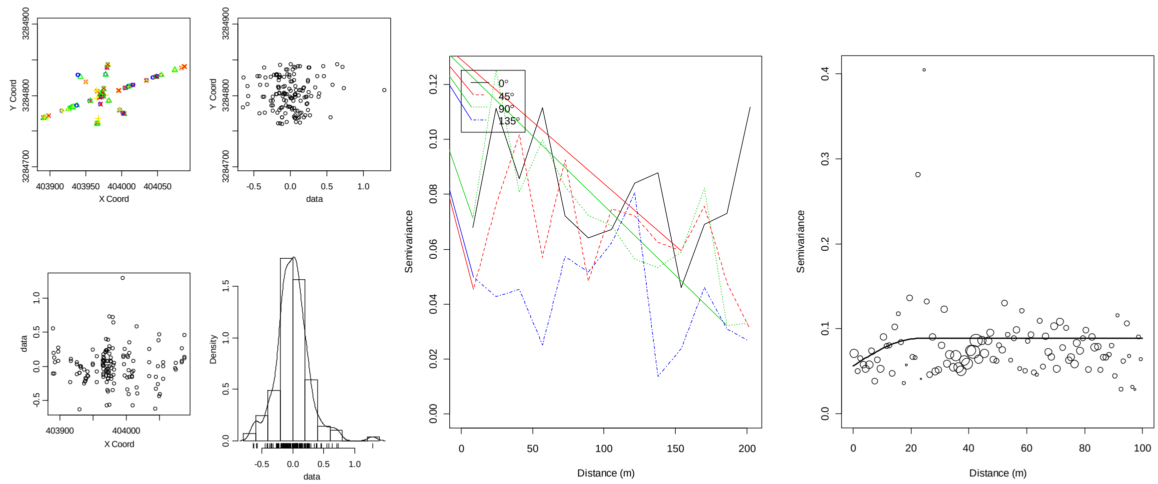


Figure 9. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

3.2.3.3 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 6 m for soil temperature and 23 m for soil moisture. Based on these results and the site design guidelines the soil plots at Ordway-Swisher shall be placed 25 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 70° from the soil plot nearest the tower (i.e., first soil plot). The location of the first soil plot will be approximately 29.68941°, -81.99323° (approximately 25 m northeast of tower location). 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 29.688215, -81.993424 (primary); 29.690977, -81.99696 (alternate 1); or 29.685852, -81.9905 (alternate 2). A summary of the soil information is shown in Table 4 and site layout can be seen in Figure 10.

Dominant soil series at the site: Candler fine sand, 0 to 5 percent slopes. The taxonomy of this soil is shown below:
Order: Entisols
Suborder: Psamments
Great group: Quartzipsamments
Subgroup: Lamellic Quartzipsamments
Family: Hyperthermic, uncoated Lamellic Quartzipsamments

Series: Candler fine sand, 0 to 5 percent slopes

Table 4. Summary of soil array and soil pit information at Ordway.
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	25 m
Distance from tower to closest soil plot: y	24 m
Latitude and longitude of 1st soil plot OR direction from tower	29.68941°, -81.99323°
Direction of soil array	70°
Latitude and longitude of FIU soil pit	29.689097°, -81.99315°
Dominant soil type	Candler fine sand, 0 to 5 percent slopes
Expected soil depth	>2 m
Depth to water table	>2 m
Soil pit 1 (primary)	29.688215, -81.993424
Soil pit 2 (alternate 1)	29.690977, -81.99696
Soil pit 3 (alternate 2)	29.685852, -81.9905

Expected depth of soil horizons	**Expected measurement depths***
0-0.10 m (fine sand)	0.05 m
0.10-1.55 m (fine sand)	0.83 m
1.55-2 m (fine sand)	1.78 m
	2.00 m

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

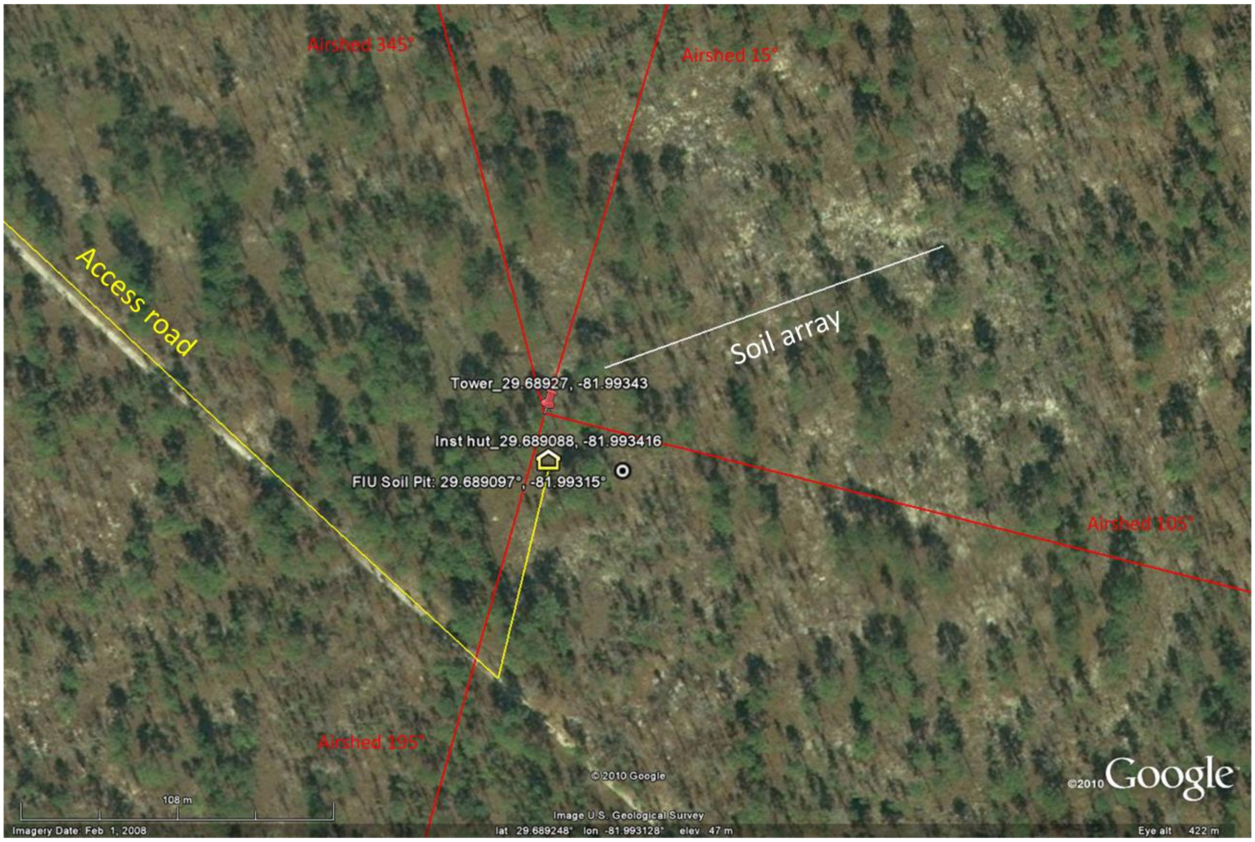


Figure 10. Site layout at Ordway-Swisher Advance site showing soil array and location of the FIU soil pit. Note that the soil pit(s) has moved; see text above for new soil pit locations.

3.3 Airshed

3.3.1 Seasonal windroses

Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given time series, Figure 11-13. The weather data used to generate the following wind roses are from Gainesville FL Airport which is ~27 km away from Ordway Advanced tower site. The orientation of the wind rose follows that of a compass (assume declination applied). When we describe the wind directions it should be noted that they are the cardinal direction that wind blows from. Color bands depict the range of wind speeds. 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.

3.3.2 Results (graphs for wind roses)

General (seasonal) circulation pattern Spring conditions shift toward mesoscale climate dominated by the sub-tropical Hadley cell and the Bermuda High. Weather comes predominately form the S-SE. Strom fronts push the weather patterns toward the E. The short winter circulations are controlled by the temperate Hadley cell, highs originating from the continental US. Storm fronts are often associated on an SW-NE frontal during the winter (From FIU site visit report in 2008, and see Meyers and Ewel 1990).

At this site, wind comes from all direction. We selected a direction that has relatively higher frequency as our dominant wind direction to run footprint model. In winter season, we select 315^o as model input, but wind comes from all directions. In spring, wind mainly from east and west, high frequency wind ranges from 45^o to 105^o and from 225^o to 345^o. In summer, wind mainly comes from northeast direction (ranges from 15^o to 105^o) and south west direction (ranges from 195^o to 285^o). We selected 75^o and 255^o as model inputs. In autumn, wind mainly comes from north east direction and ranges from 315^o to 75^o). But we should keep in mind that wind actually comes from all directions in all seasons; these data can be found in the wind roses. Therefore, the tower shall be placed in the center of the ecosystem in question to ensure as much valid information is captured from this ecosystem as possible.

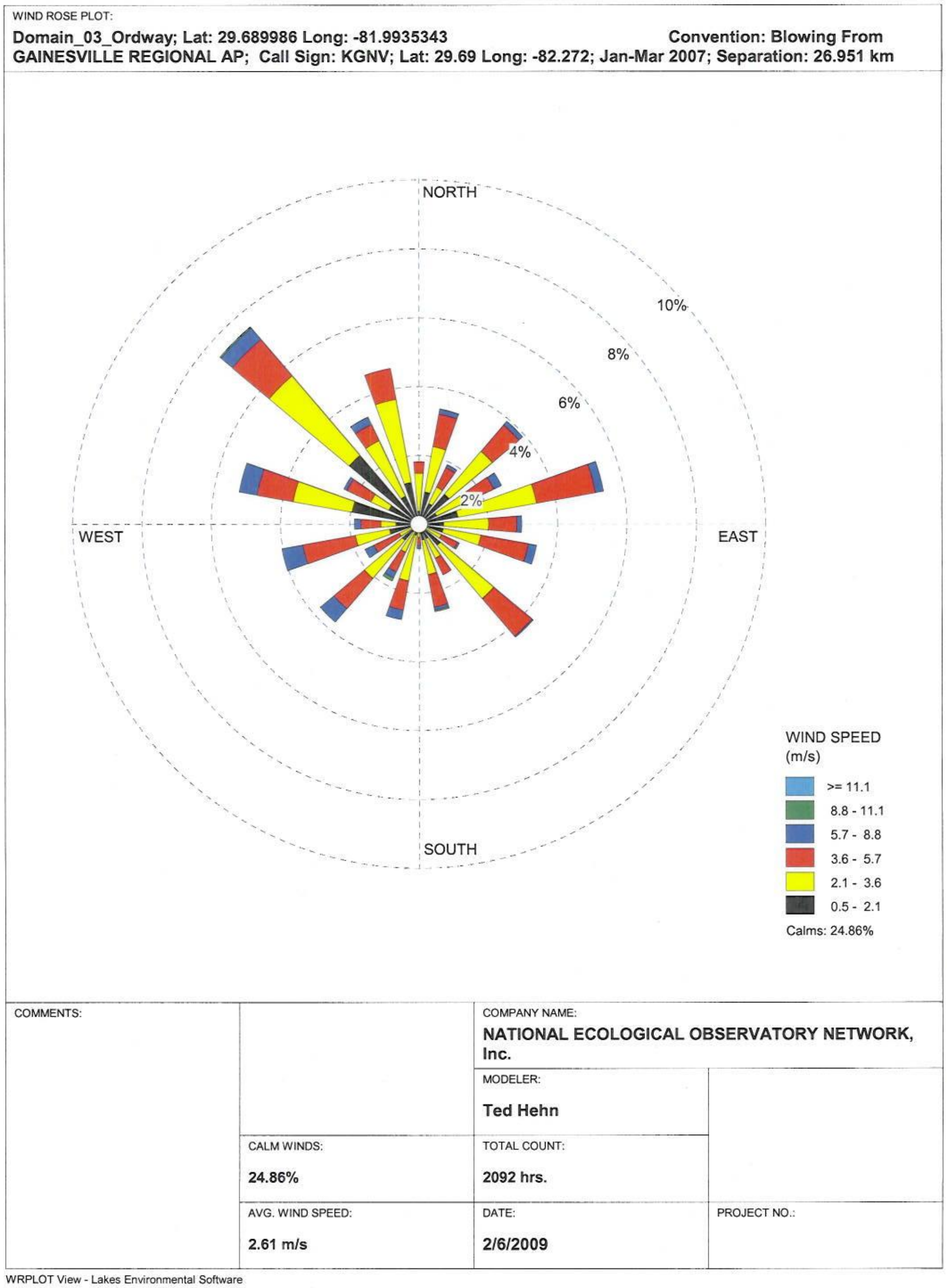


Figure 11. Windroses of January – March for D03 Ordway Advanced site.

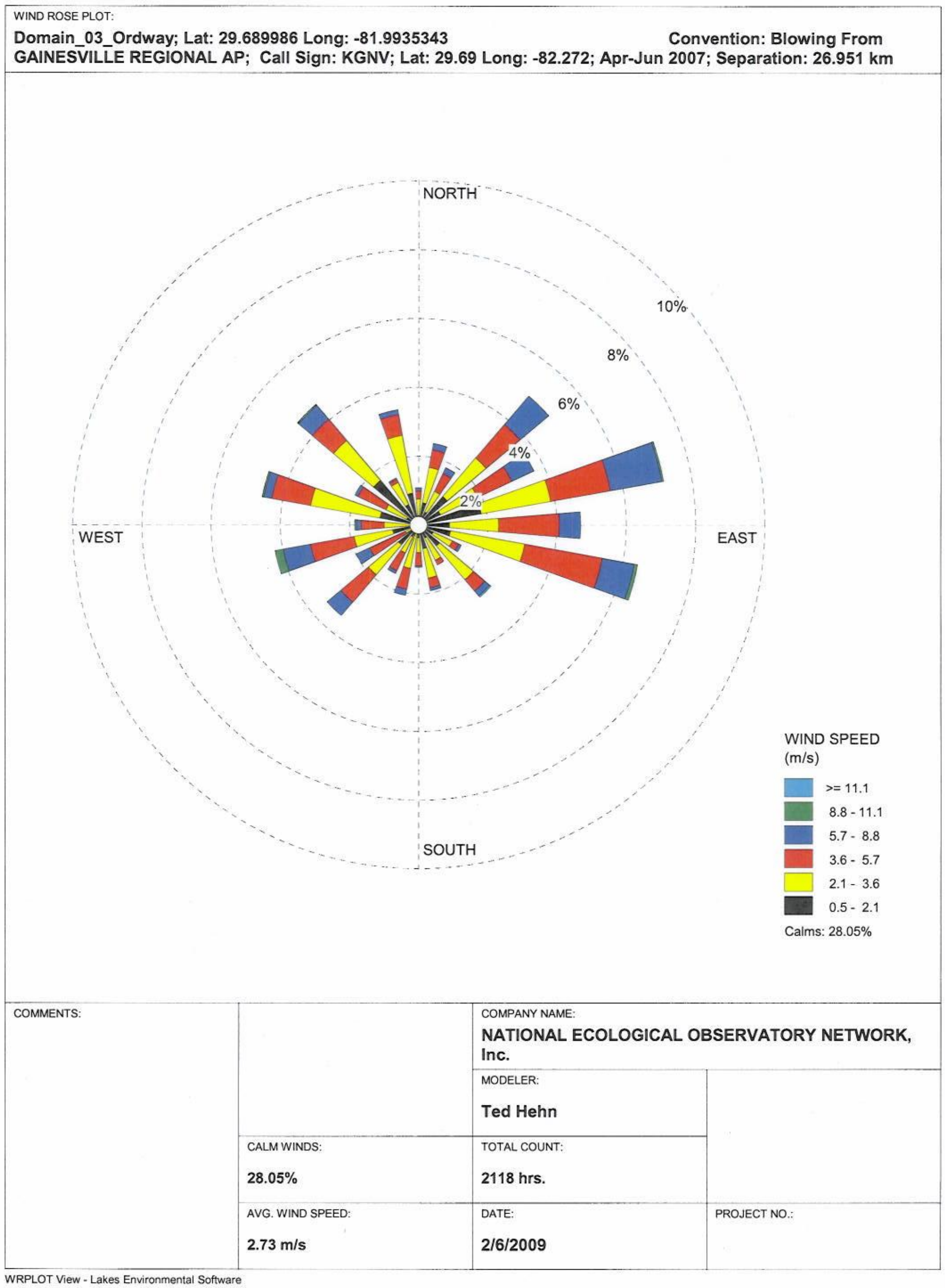


Figure 12. Windroses of April – June for D03 Ordway Advanced site.

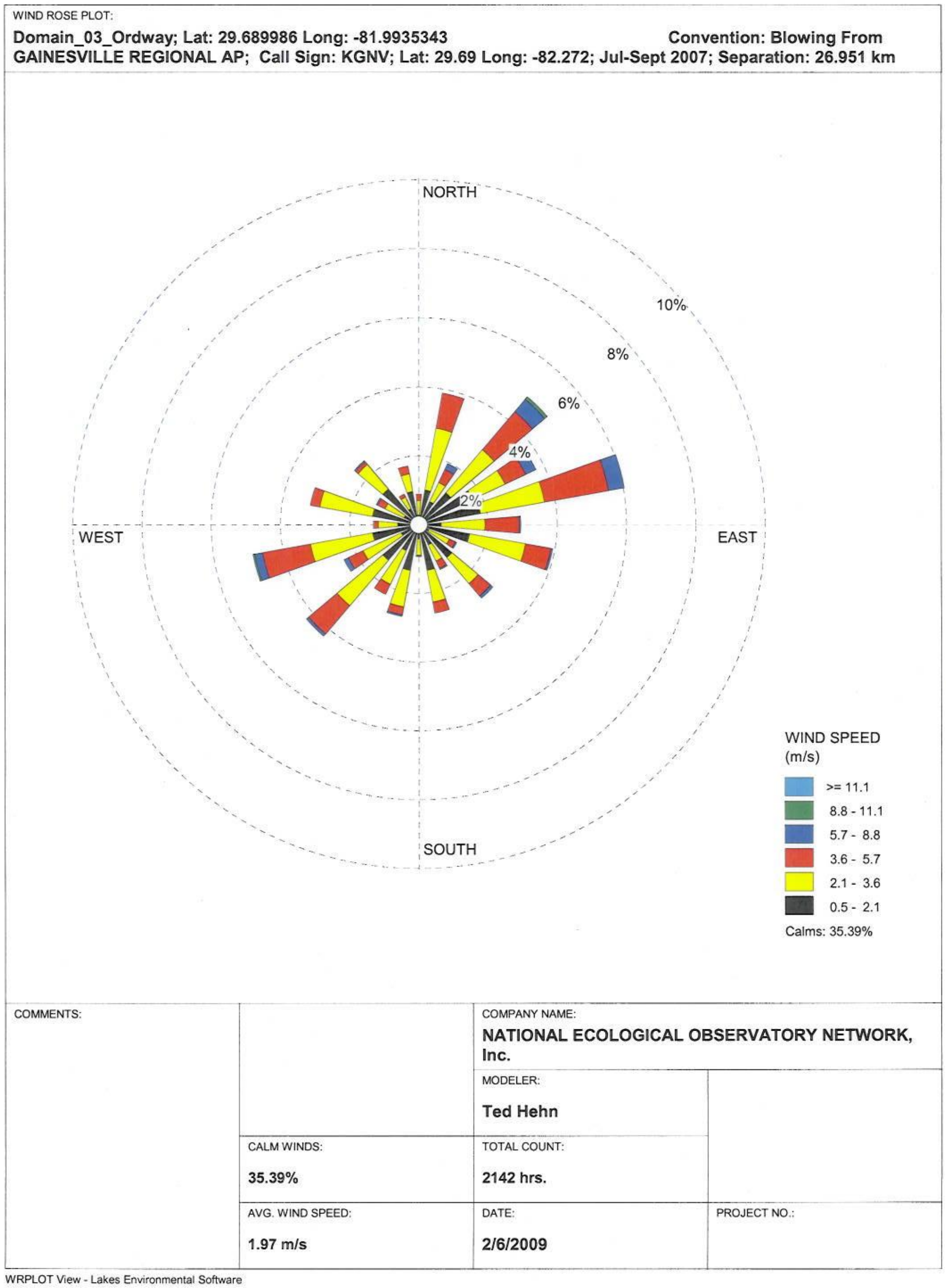


Figure 13. Windroses of July – September for D03 Ordway Advanced site.

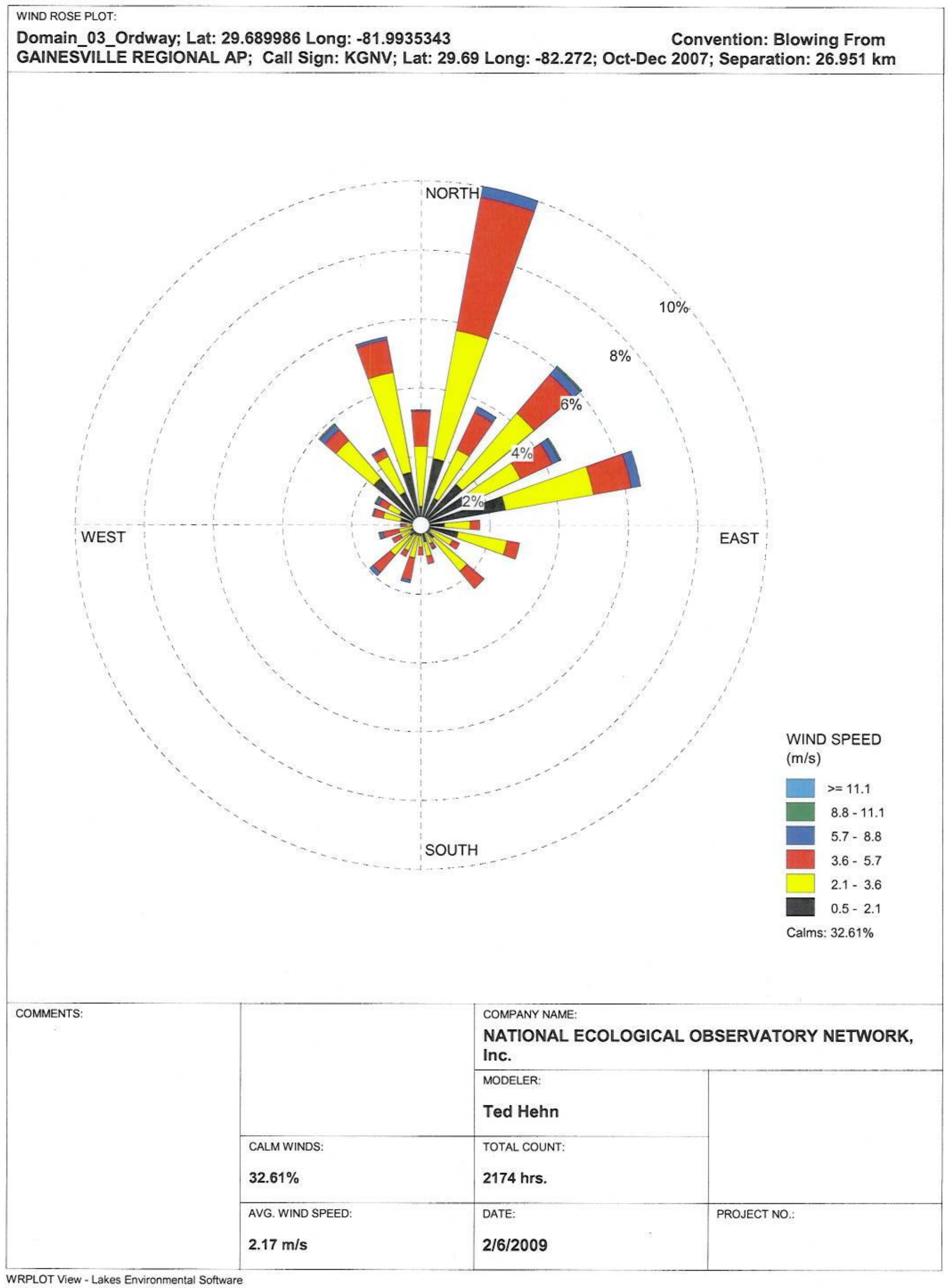


Figure 14. Windroses of October - December for D03 Ordway Advanced site.

3.3.3 Resultant vectors

Table 5. The resultant wind vectors for D03 Ordway Advanced site.

Quarterly (seasonal) timeperiod	Resultant vector	% duration
January to March	355°	34
April to June	13°	35
July to September	9°	36
October to December	13°	60
Annual mean	7.5°	na.

3.3.4 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, with support from Dr R. Clement, we use a web-based footprint model that programmed by Micrometeorology Group at University of Edinburgh, UK 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 estimates from experienced expert. Measurement height was obtained 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 wind speeds (daytime convective) and nighttime (stable atmospheres) conditions. The wind vector for each run was extracted from wind roses and is placed as a centerline in the site map included in the graphics. The longest distance between the isopleth of 80% cumulative flux and tower, along with the major 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 for Ordway-Swisher Biological Center Relocatable site.

Parameters	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**	
Approximate season	summer			winter			Units
	Day (max WS)	Day (mean WS)	Night	Day (max WS)	Day (mean WS)	night	qualitative
Atmospheric stability	Convective	convective	Stable	Convective	convective	Stable	qualitative
Measurement height	33	33	33	33	33	33	m
Canopy Height	23	23	23	23	23	23	m
Canopy area density	2	2	2	2	2	2	m
Boundary layer depth	2800	2800	1300	900	900	500	m
Expected sensible heat flux	425	425	125	175	175	60	W m^{-2}
Air Temperature	30	30	22	15	15	10	°C
Max. windspeed	8.8	3.1	1.2	8.8	2.9	1.1	m s^{-1}
Resultant wind vector	75/255	75/255	75/255	315	315	315	degrees
Results							
(z-d)/L	-0.02	-0.24	-0.18	-0.01	-0.19	-0.29	m
d	17	17	17	17	17	17	m
Sigma v	3.40	2.30	1.40	3.00	1.50	0.87	m^2 s^{-2}
Z0	1.30	1.30	1.30	1.30	1.30	1.30	m
u*	1.40	0.67	0.50	1.40	0.55	0.34	m s^{-1}
Distance source area begins	0	0	0	0	0	0	m
Distance of 90% cumulative flux	800	400	200	900	420	250	m
Distance of 80% cumulative flux	450	250	100	480	250	150	m
Distance of 70% cumulative flux	350	200	50	400	180	100	m
Peak contribution	65	35	15	65	45	25	m

3.3.5 Footprint model results (source area graphs)

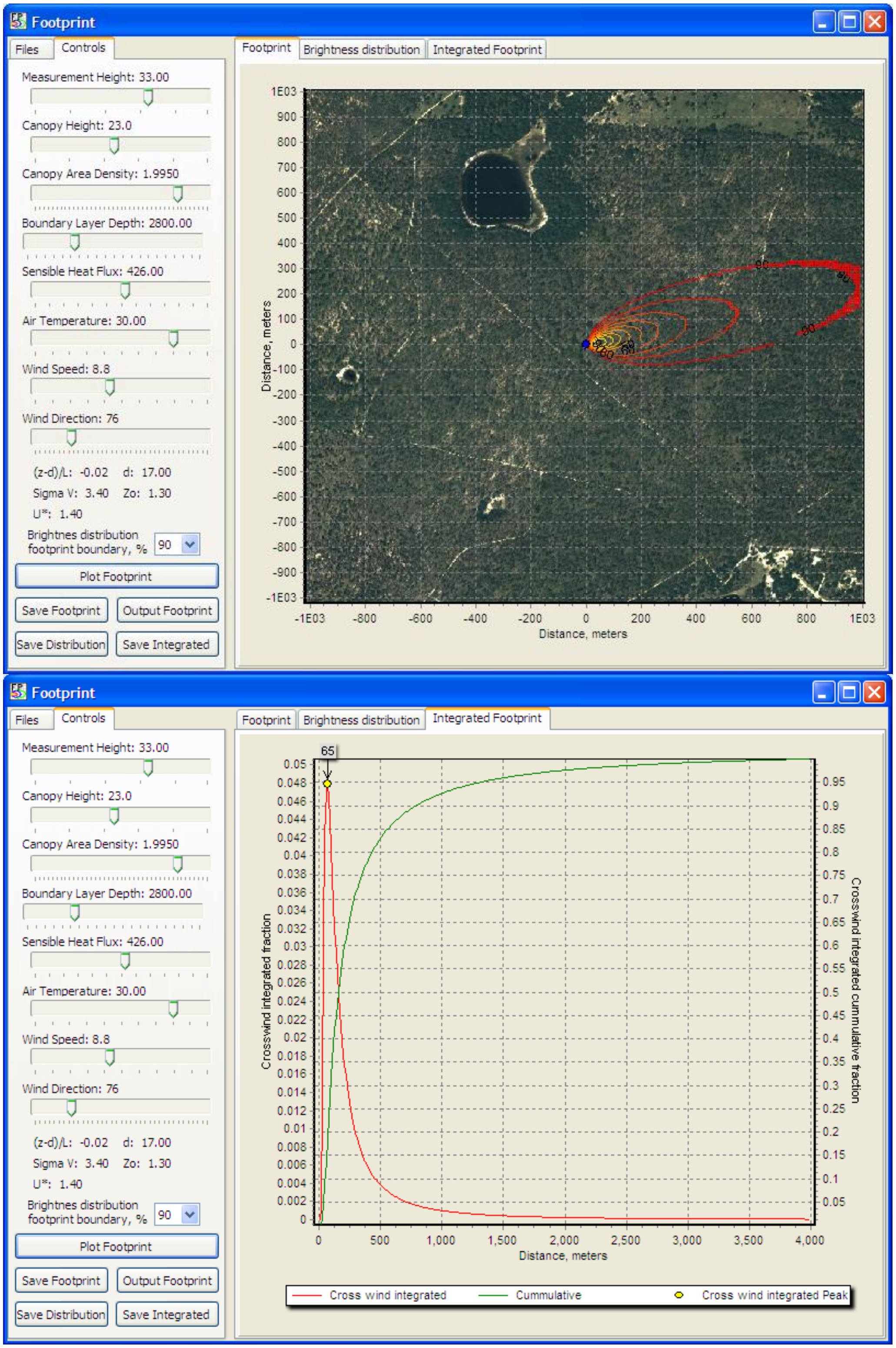


Figure 15. Footprint model Run 1: summer, daytime, max WS, WD 75 degrees

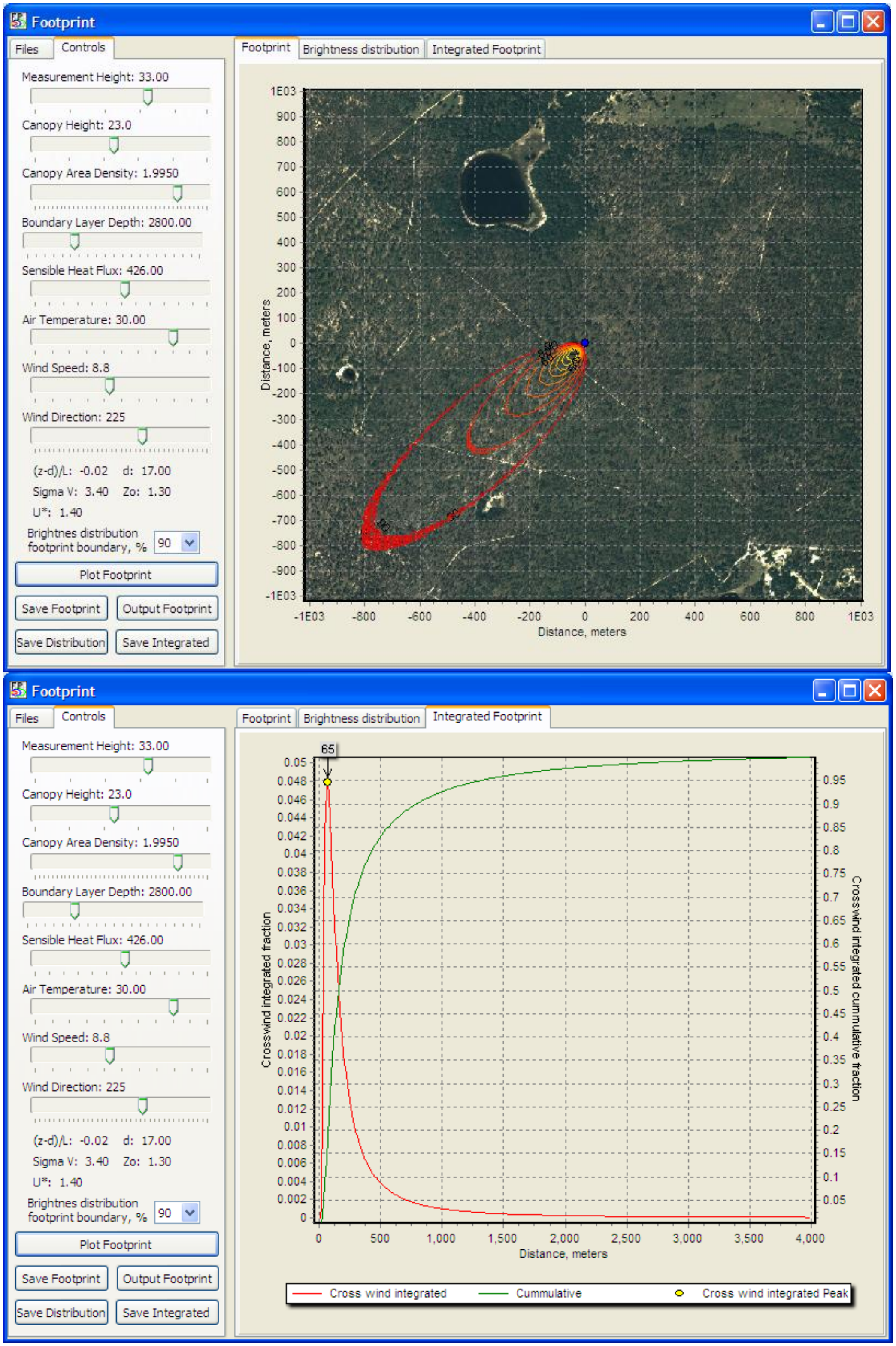


Figure 16. Footprint model Run 1: summer, daytime, max WS, WD 225 degrees

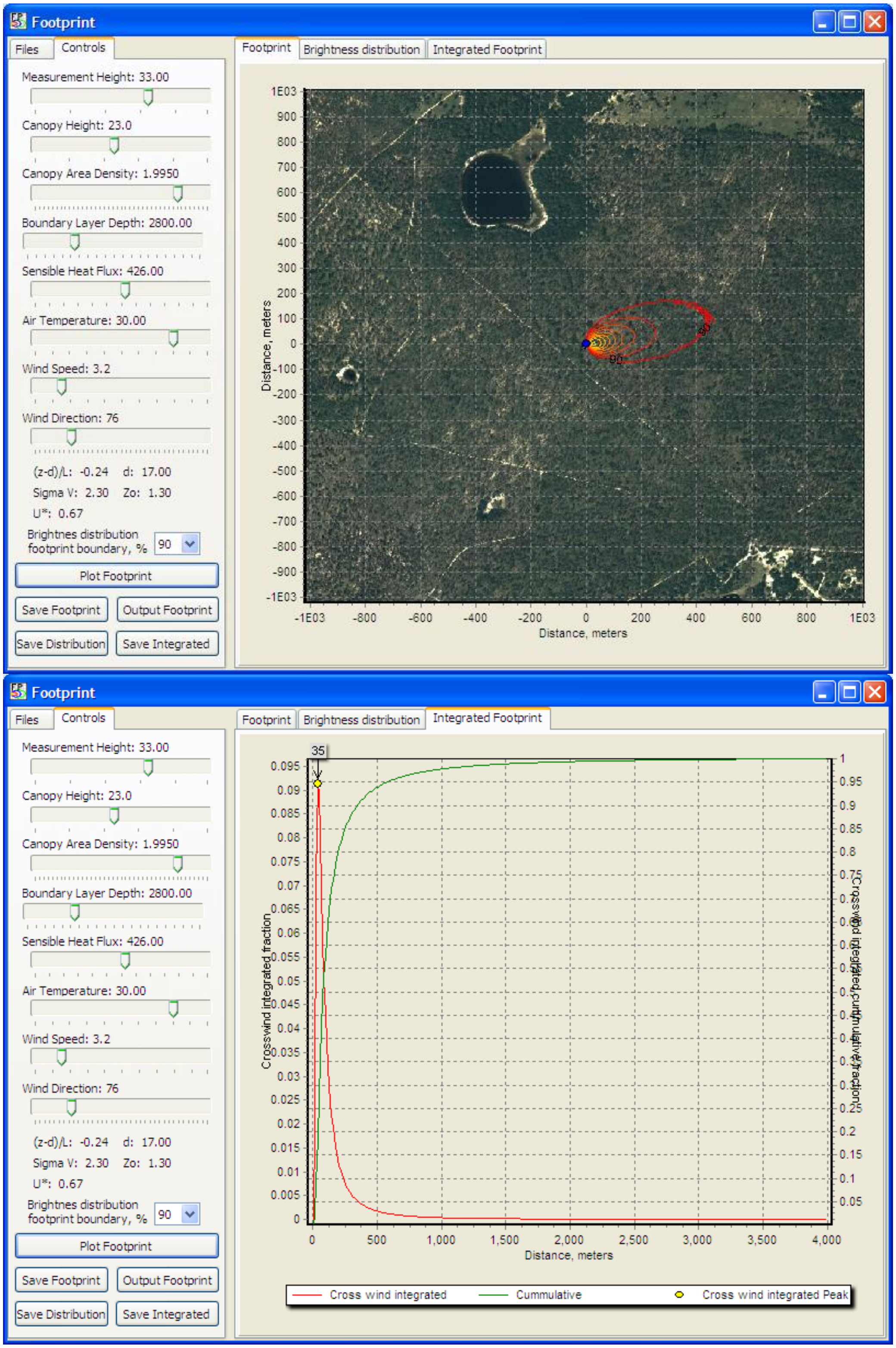


Figure 17. Footprint model Run 2: summer, daytime, mean WS, WD 75 degrees

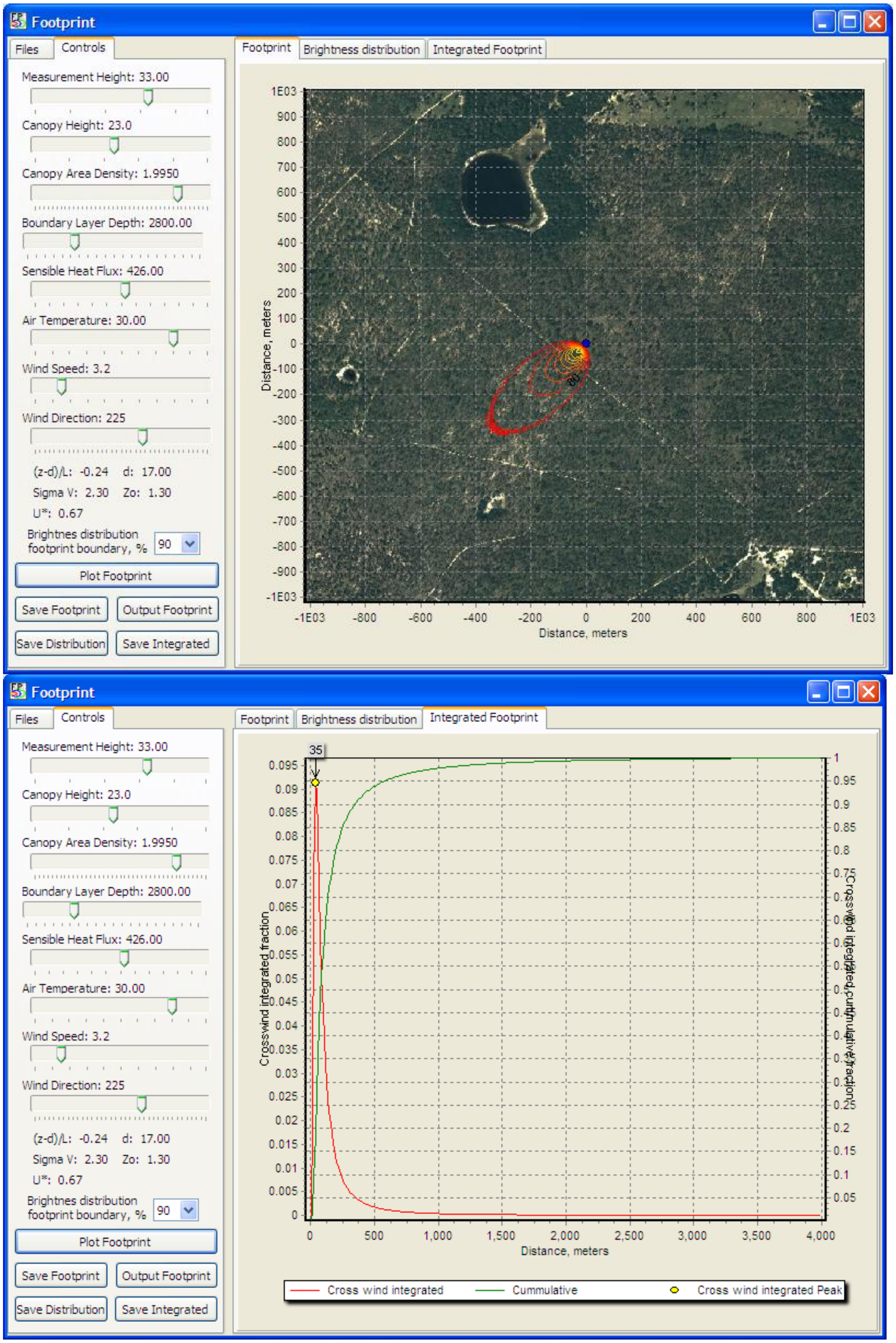


Figure 18. Footprint model Run 2: summer, daytime, mean WS, WD 225 degrees

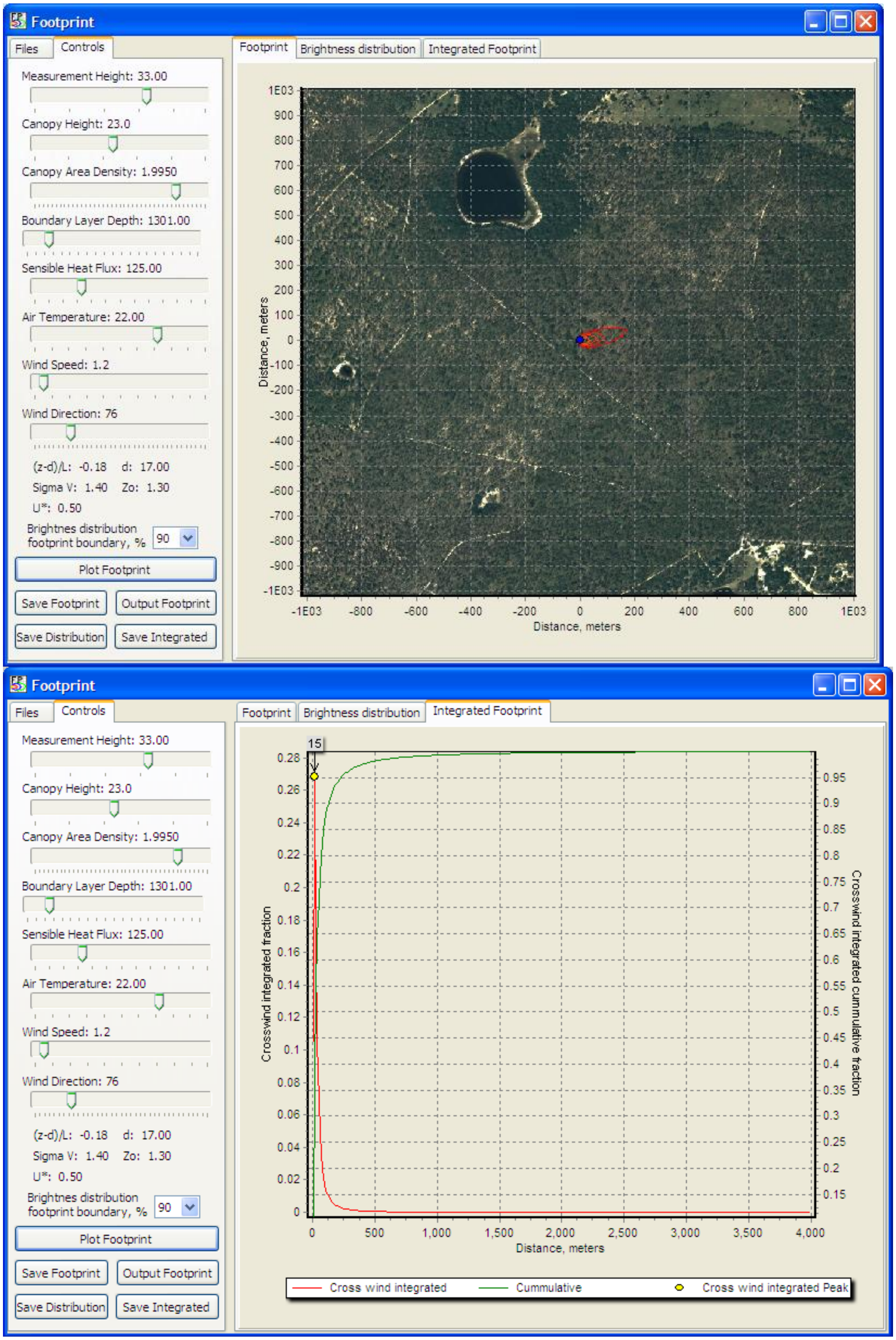


Figure 19. Footprint model Run 3: summer, nighttime, mean WS, WD 75 degrees

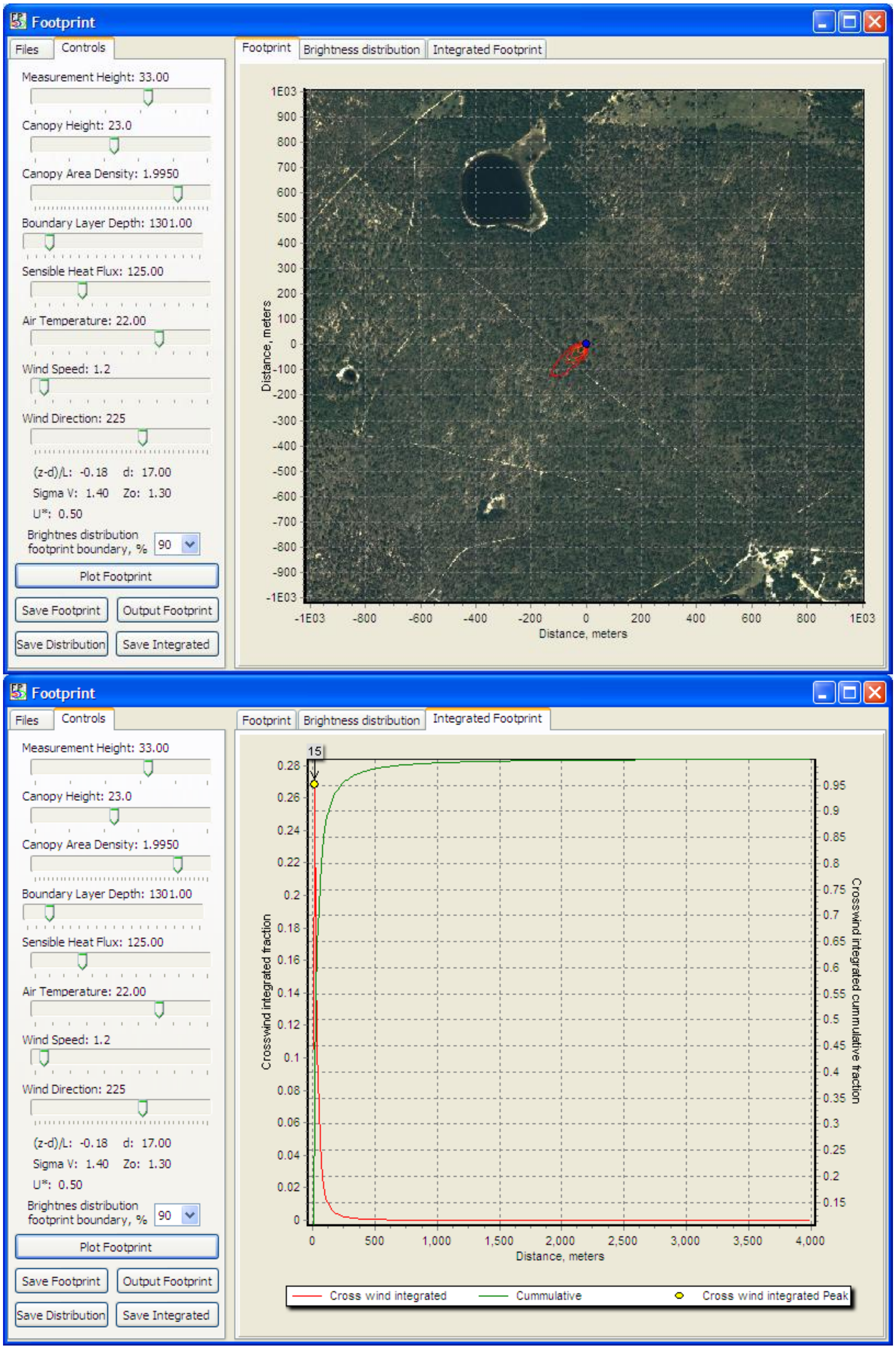


Figure 20. Footprint model Run 3: summer, nighttime, mean WS, WD 225 degrees

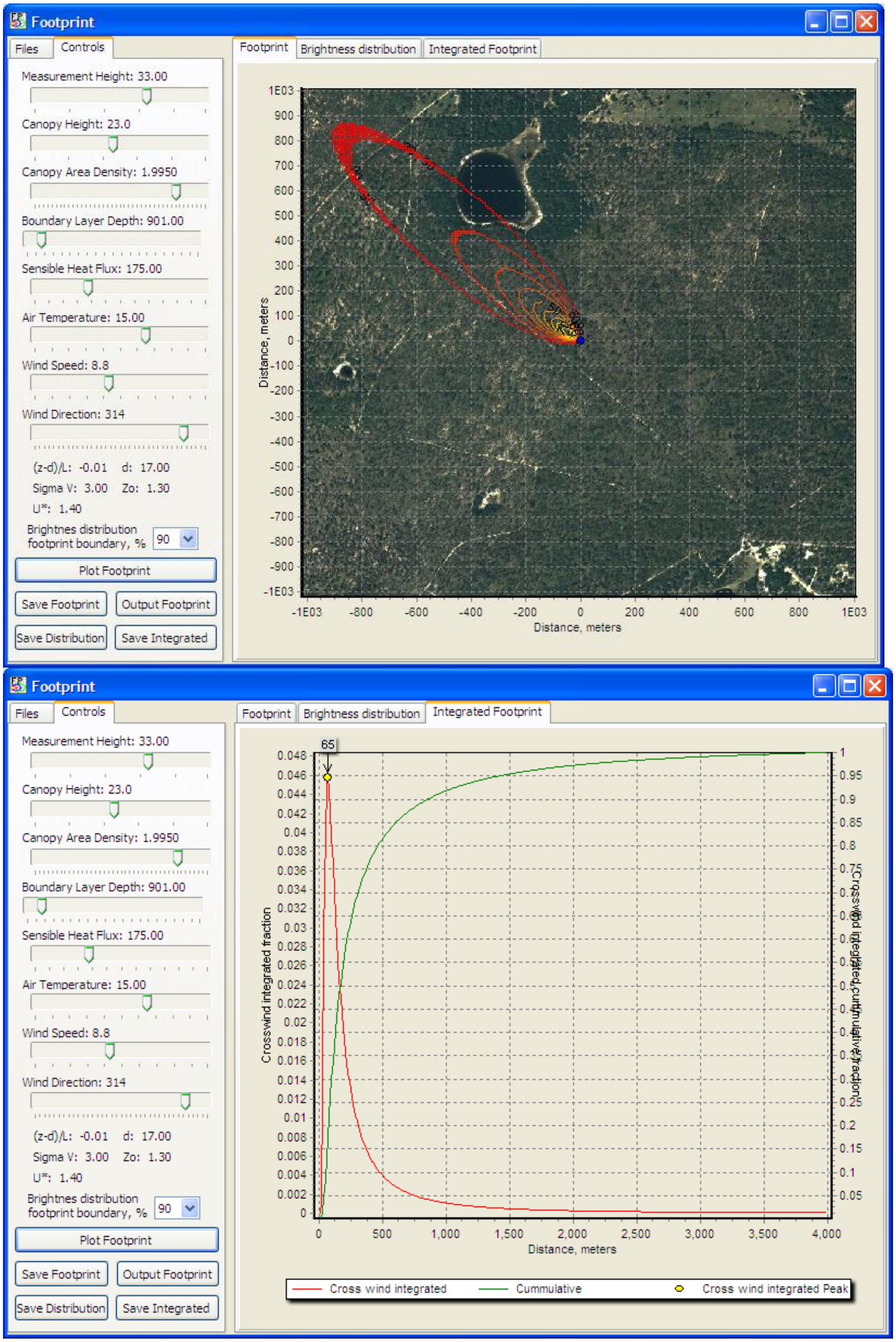


Figure 21. Footprint model Run 4: winter, daytime, max WS

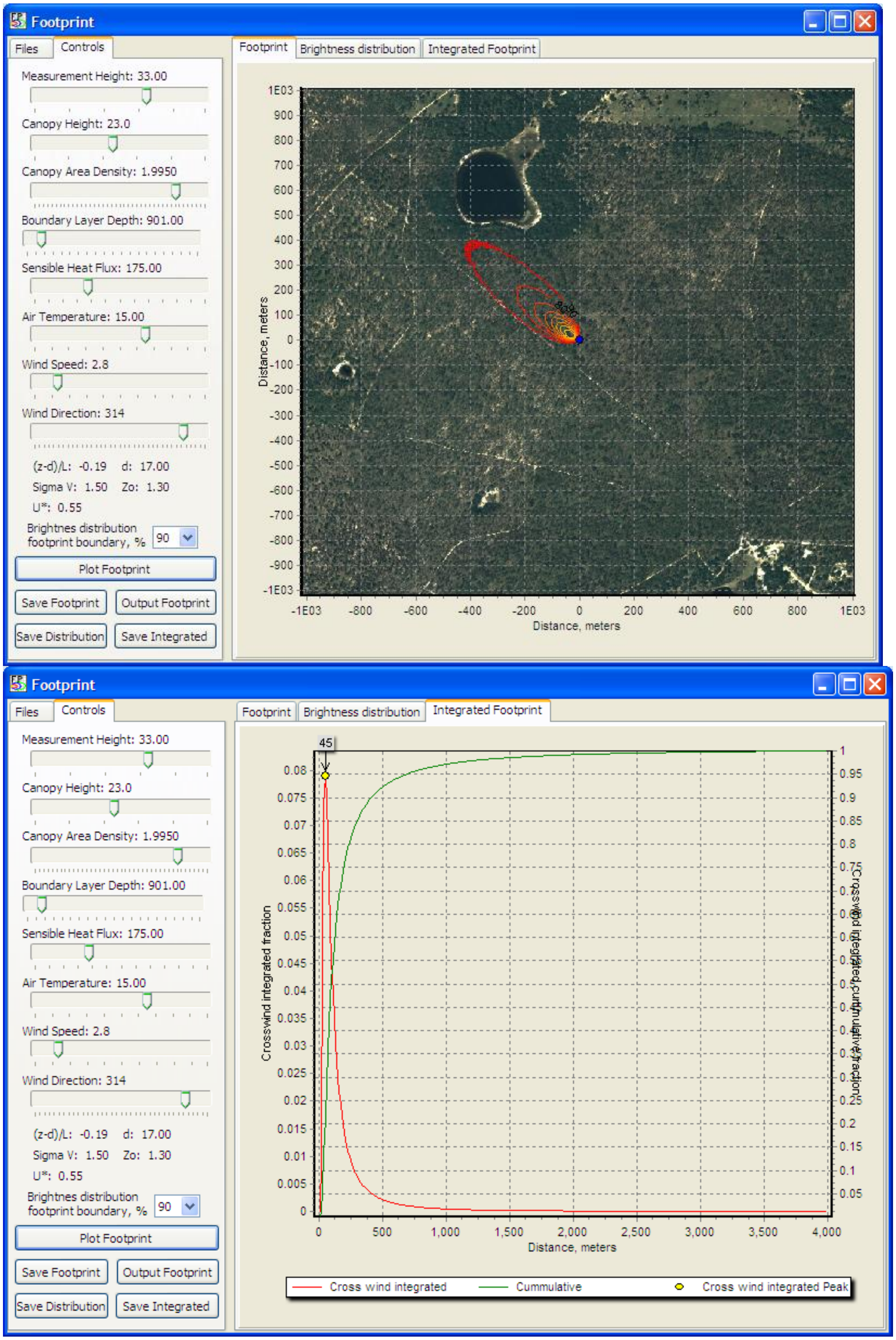


Figure 22. Footprint model Run 4: winter, daytime, mean WS

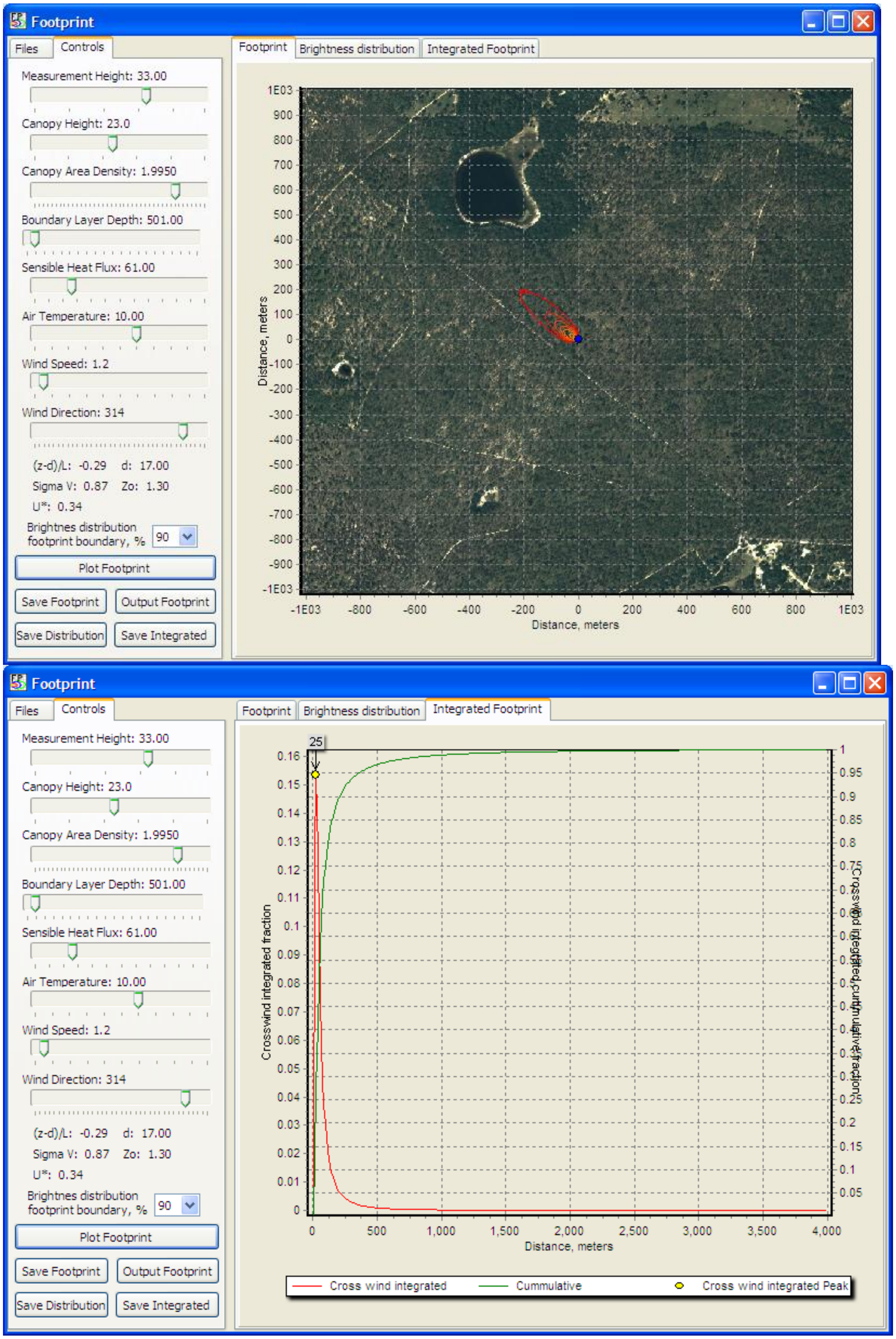


Figure 23. Footprint model Run 4: winter, nighttime, mean WS

3.3.6 Tower location, instrument hut location, boardwalks, measurement layers on the tower and other sensor locations

At this site, wind comes from all directions. In spring, wind has higher frequency to blow from east and west, high frequency wind ranges from 45° to 105° and from 225° to 345°. In summer, wind mainly comes from northeast direction (ranges from 15° to 105° originating from the Bermuda high) and south west direction (ranges from 195° to 285° often associated with convective cells). Therefore, consider both winter and summer season, wind blows more frequently from 15° to 105° (clockwise from 15°, this is major airshed area) and from 195° to 345° (clockwise from 195°, less important airshed area). The footprint can reach as far as ~500 m for 80% cumulative flux measurement. The tower should be positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (longleaf pine open forest in this case). The original tower site was lat 29.68998591°, long -81.99353439°, after FIU site characterization, we determine the exact tower location to be at 29.68927°, -81.99343° to minimize the needs for tree cutting during tower construction. New location is next to the original site, and located closer to access road. Eddy covariance, sonic wind and air temperature boom arms orientation toward the SE will be best to capture signals from all major wind directions. Radiation boom arms should always be facing the S to avoid any shadowing effects from the tower structure. Instrument hut is 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, positioned toward the SW of the tower (direction with the least major winds blowing from).

This site is open pine forest. Canopy height ranges ~ 15 to 23 m around tower site and in the airshed area. Mean height for the bottom branch is ~3 m. Recruited pine seedlings (~ 11 m tall), oak seedlings (~1.2 m tall) and wiregrasses (~0.35 m tall) form different understory layers. We suggest 6 measurement layers on the tower with top measurement height at 33 m, and rest layers are 25 m, 14 m, 9 m, 1 m and 0.25 m, respectively.

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 conduit 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.

- There is always a boardwalk from the instrument hut to the tower
- There is never a boardwalk on the south side of the tower
- There is never a boardwalk within 4 m of the tower, except where it perpendicularly intersects the tower for access
- The boardwalk the access to the tower is not on any side that has a boom.

- There is never boardwalk within 10 m of a soil plot, except where it perpendicularly intersects a soil plot for access.

Specific Boardwalks at Ordway Swisher

- Boardwalk from access road to instrument hut
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower.
- Boardwalk to the soil array
- Boardwalks must be protected from controlled burns
- No boardwalk from the soil array boardwalk to the individual soil plots
- No boardwalk needed at DFIR site

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 7. Tower oriented design attributes for the Ordway-Swisher 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			345° to 105° and 195° to 285°		Clockwise from first angle
Tower location	29.68927	-81.99343	--	--	new site
DFIR	29.69760	-81.98699	--	--	
Instrument hut	29.689088°,	-81.993416°			
Instrument hut (perpendicular) orientation vector	--	--	135° to 315°		Shorter side parallel to 45° to 225°
Instrument hut distance z	--	--	--	20	
Anemometer/Temperature boom orientation	--	--	135°	--	From tower point to this direction
Height of the measurement levels					
Level 1				0.25	m.a.g.l.
Level 2				1.0	m.a.g.l.
Level 3				9.0	m.a.g.l.
Level 4				14.0	m.a.g.l.
Level 5				25.0	m.a.g.l.
Level 6				33.0	m.a.g.l.
Tower Height				33.0	m.a.g.l.

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

Figure 24 below shows the proposed tower location, instrument hut location, airshed area and access road.

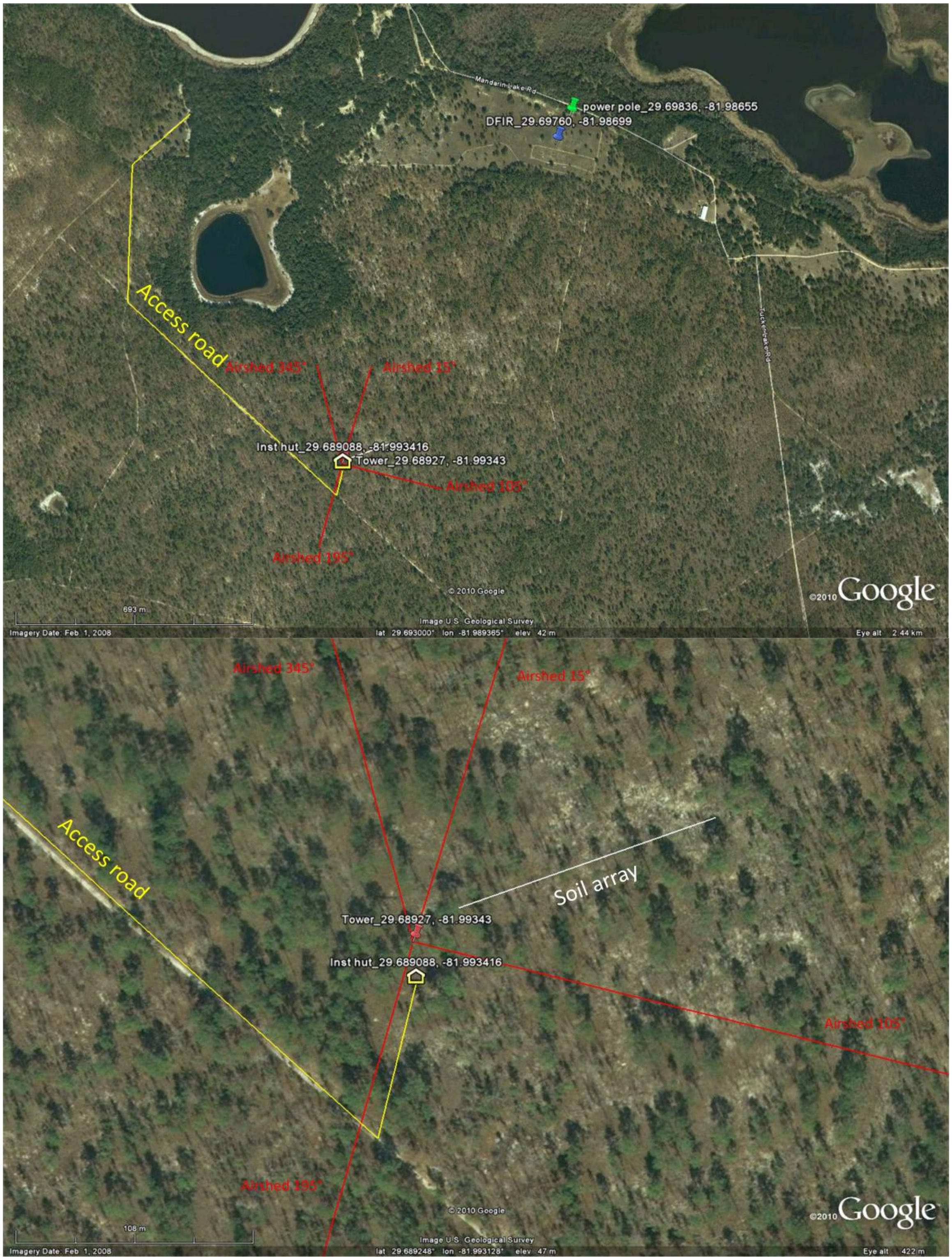


Figure 24. Plan view of D03 Ordway-Swisher Advanced site location.

i) new tower location is presented, ii) red lines indicate the airshed boundaries. Vectors 15° and 105° (starting clockwise from 15°) and vectors 195° and 345° (starting clockwise from 195°) bound the airshed, within which it would have quality wind data without causing flow distortions, respectively, iii) Yellow line is the suggested access road to instrument hut, iv) White line indicates soil array. v) Blue pin indicates the location for DFIR, and vi) Green pin indicates closest power pole from DFIR, which is ~90 m from the DFIR.

Keep in mind that all **radiation sensors** above canopy need to be mounted on the south side of the tower to avoid shadow from tower structure and mounting parts.

DFIR (Double Fenced International Reference) for bulk precipitation collection will be located at a water catchment on the north-east direction of tower about 1100 m away at Lat. 29.69760, Long. -81.98699. **Wet deposition collector** will be located on the top of the tower. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

3.3.7 Information for ecosystem productivity plots

The tower at Ordway-Swisher Advanced site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (longleaf pine forest). Wind vectors from the tower dictate the airshed is from 15^o to 105^o (clockwise from 15^o, this is major airshed area) and from 195^o to 345^o (clockwise from 195^o, relatively less important airshed area) in Figure 24, and 80% signals for flux measurements are within a distance of 500 m from tower. We recommend that the FSU Ecosystem Productivity plots should be placed within the airshed boundaries of the 15 degrees line and the 105 degree line(clockwise from 15^o, major airshed area).

4 DISNEY (RELOCATABLE TOWER SITE 1)

4.1 Site Description

The Disney Wilderness Preserve is located south of Orlando in Osceola and Polk counties and covers 12,000 acres. There are several ecosystem types in the preserve boundary. The ecosystem we are interested in is the restored Broom sedge (*Andropogon sp.)* prairie. Original tower location was 28.122766, -81.434897, which was in the middle of the grassland. After footprint analysis and site visit, we decide to microsite tower location to lat 28.12504°, long -81.43620° to optimize the measurements from the grassland.

4.1.1 Ecosystem

Dominant vegetation types within Preserve include Pine Flatwoods, Southern Coastal Plain Nonriverine Cypress Dome, and Florida Dry Prairie. **This site is seasonally wet and flooded—and is a fire-dominated system with controlled burns.** Mean canopy height in the forest is between 10 m and 25 m, while in the prairie mean canopy height is between 0.5 m and 1 m. Abrahamson and Hartnett (1990) and Meyers and Ewel (1990) provides additional information about this ecosystem.

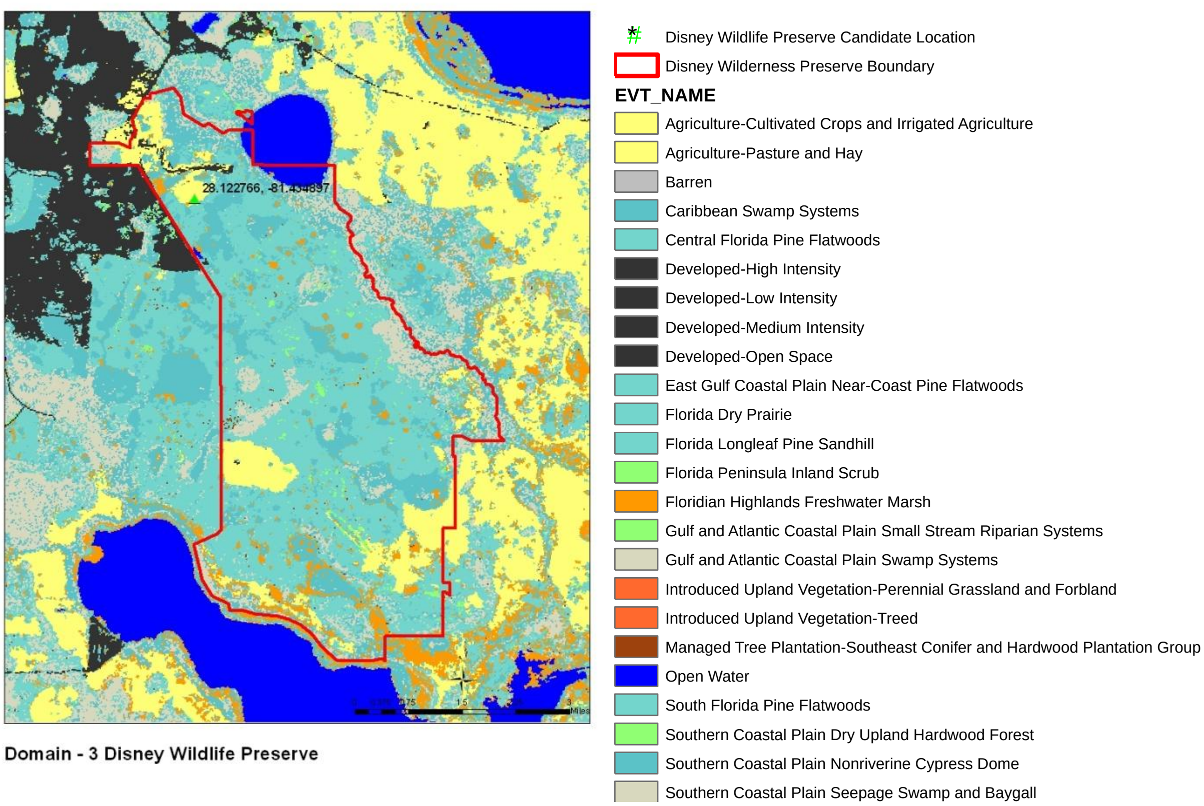


Figure 25. Vegetation map for Disney NEON relocatable tower site 1 and surrounding area (information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm).

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

Veg_Type	Area (km^2)	%
Agriculture-Cultivated Crops and Irrigated Agriculture	3.83	8.09
Caribbean Swamp Systems	0.58	1.23
Central Florida Pine Flatwoods	4.63	9.78
Developed-Low Intensity	0.01	0.02
Developed-Open Space	0.31	0.66
East Gulf Coastal Plain Near-Coast Pine Flatwoods	0.04	0.07
Florida Dry Prairie	4.94	10.43
Florida Peninsula Inland Scrub	0.51	1.09
Floridian Highlands Freshwater Marsh	2.27	4.79
Gulf and Atlantic Coastal Plain Swamp Systems	2.60	5.50
Introduced Upland Vegetation-Perennial Grassland and Forbland	0.00	0.01
Managed Tree Plantation-Southeast Conifer and Hardwood Plantation Group	0.10	0.21
Open Water	0.62	1.32
South Florida Pine Flatwoods	14.60	30.84
Southern Coastal Plain Dry Upland Hardwood Forest	0.01	0.01
Southern Coastal Plain Nonriverine Cypress Dome	9.91	20.93
Southern Coastal Plain Seepage Swamp and Baygall	2.38	5.02
Total	**47.34**	**100.00**

The ecosystem we are interested in is the restored Broom sedge (*Andropogon sp.)* prairie. Broom sedge is a perennial grass that forms clumps in many pastures, hay fields, and abondoned fields, and often goes unnoticed until it matures into a reddish-brown clump of broom-like leaves. Found in the eastern half of the United States and in California. It dies back every fall then regrows from the same root mass the following spring. The stiff, erect stems reach 3' to 4' in height. Broomsedge grows well on open ground, along roadsides, or forest edges and along salt marshes. It is often found in disturbed sites and is an early volunteer in new forest plantations.

The Broom sedge prairie we did the field survey has height between 1 m to 1.5 m. Some pine forests are on the east, northeast and southeast edges of the prairie. Tree height is ~25 m, but > 400 m away. The distance from tower to the tree line is larger than 5 times of the tree height to avoid the edge effects. Controlled burn is conducted every 2 – 3 years. The ecosystem attributes to this site are summarized as following:

Table 9. Ecosystem and site attributes for the Disney Wildness Preserve Relocatable site.

Ecosystem attributes	Measure and units
Mean canopy height	1.5 m
Surface roughness[a]	0.1 m
Zero place displacement height[a]	1.0 m
Structural elements	Short, uniform, homogeneous
Altitude[b]	50 [m] a.s.l.
Slope	0%
Aspect	±0
Time zone	Atlantic
Magnetic declination	5° 34' W
Frost-free period	365 days

Note, [a] From footprint analysis below.

[b] Best estimate

4.2 Soils

4.2.1 Soil Description

Soil data and soil maps (Figures 26) below for Disney relocatable tower site 1 were collected from 2.4 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.

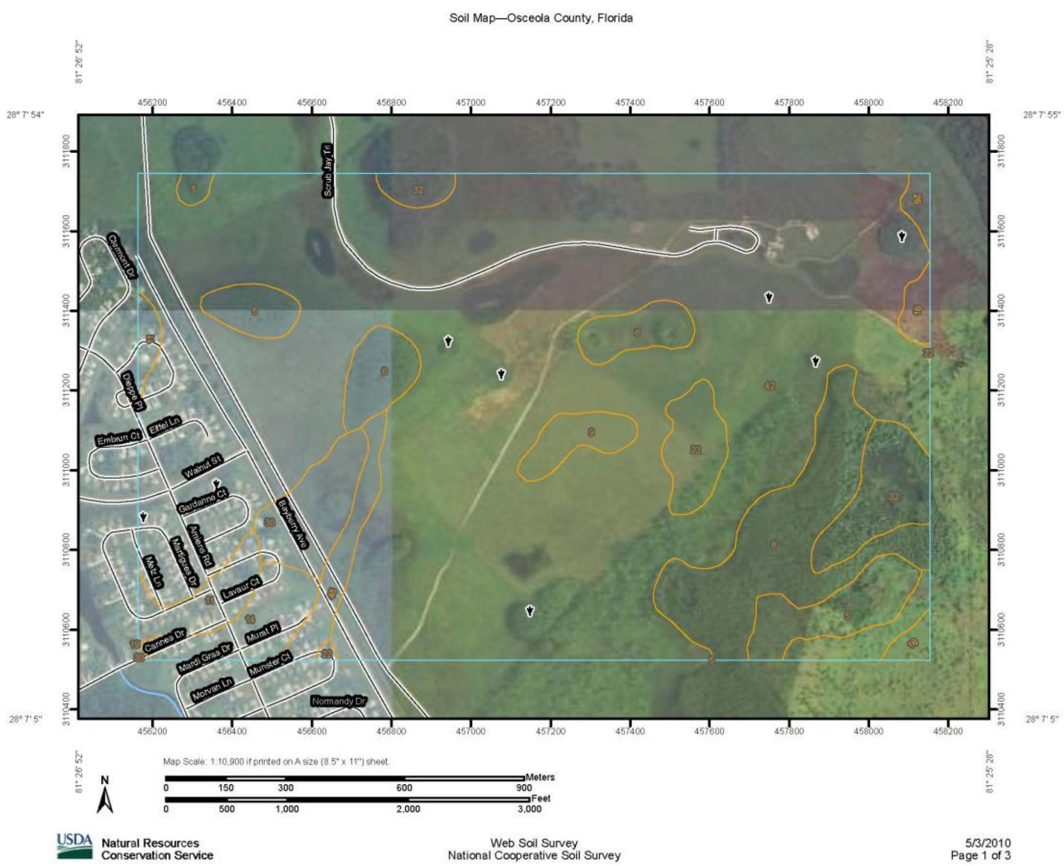


Figure 26. 2.4 km^2 soil map for Disney relocatable site 1, center at tower location.

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 2.4 km^2 centered on the tower. Area Object Interest (AOI) is the mapping unit from NRCS

	Osceola County, Florida (FL097)		
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
5	Basinger fine sand	17.8	3.40%
6	Basinger fine sand, depressional	69.1	*13.00%
9	Cassia fine sand	6.9	1.30%
11	EauGallie fine sand	5.6	1.10%
14	Holopaw fine sand	14.5	2.70%
16	Immokalee fine sand	21.8	4.10%
19	Malabar fine sand	0	0.00%
22	Myakka fine sand	17.2	3.30%
26	Oldsmar fine sand	2.2	0.40%
30	Pineda fine sand	15.2	2.90%
32	Placid fine sand, depressional	14.9	2.80%
42	Smyrna fine sand	332.4	*62.80%
45	Wabasso fine sand	13.7	2.60%
Total		**600.9**	**100.00%**

Note, asterisk indicates dominant soil type(s) in airshed

Osceola County, Florida (FL097)- Basinger fine sand: Map Unit Setting Elevation: 10 to 100 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Basinger and similar soils: 85 percent Minor components: 15 percent **Description of Basinger Setting** Landform: Drainageways on marine terraces, flats on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave Parent material: Sandy marine 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): Very high (19.98 to 39.96 in/hr) Depth to water table: About 0 to 12 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Very low (about 3.0 inches) **Interpretive groups** Land capability (nonirrigated): 4w **Typical profile** 0 to 7 inches: Fine sand 7 to 19 inches: Fine sand 19 to 35 inches: Fine sand 35 to 80 inches: Fine sand **Minor Components Placid** Percent of map unit: 5 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Pompano** Percent of map unit: 5 percent Landform: Drainageways on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Smyrna** Percent of map unit: 5 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida (FL097)-Basinger fine sand, depressional: Map Unit Setting Elevation: 10 to 100 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Basinger, depressional, and similar soils: 85 percent Minor components: 15 percent **Description of Basinger, Depressional Setting** Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave

Across-slope shape: Concave Parent material: Sandy marine deposits **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Very poorly drained Capacity of the most limiting layer to transmit water (Ksat): Very high (19.98 to 39.96 in/hr) Depth to water table: About 0 inches Frequency of flooding: None Frequency of ponding: Frequent Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Very low (about 3.0 inches) **Interpretive groups** Land capability (nonirrigated): 7w **Typical profile** 0 to 4 inches: Fine sand 4 to 28 inches: Fine sand 28 to 42 inches: Fine sand 42 to 80 inches: Fine sand **Minor Components Placid** Percent of map unit: 4 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Pompano** Percent of map unit: 4 percent Landform: Drainageways on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Myakka** Percent of map unit: 4 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Smyrna** Percent of map unit: 3 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida (FL097)-Cassia fine sand: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Cassia and similar soils: 95 percent Minor components: 5 percent **Description of Cassia Setting** Landform: Rises on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear Parent material: Sandy marine 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 (0.57 to 5.95 in/hr) Depth to water table: About 18 to 42 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Low (about 5.6 inches) **Interpretive groups** Land capability (nonirrigated): 6s **Typical profile** 0 to 3 inches: Fine sand 3 to 20 inches: Fine sand 20 to 28 inches: Loamy fine sand 28 to 53 inches: Fine sand 53 to 80 inches: Fine sand **Minor Components Myakka** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Pomello** Percent of map unit: 2 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida (FL097)- EauGallie fine sand: Map Unit Setting Elevation: 20 to 100 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Eaugallie and similar soils: 90 percent Minor components: 10 percent **Description of Eaugallie Setting** Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear Parent material: Sandy and loamy marine 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 (0.57 to 5.95 in/hr) Depth to water table: About 6 to 18 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Low (about 3.3 inches) **Interpretive groups** Land capability (nonirrigated): 4w **Typical profile** 0 to 6 inches: Fine sand 6 to 23 inches: Fine sand 23 to 34 inches: Fine sand 34 to 54 inches: Fine sand 54 to 80 inches: Sandy clay loam **Minor Components Basinger** Percent of map unit: 2 percent Landform: Drainageways on marine terraces, flats on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Immokalee** Percent of map unit: 2 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Malabar** Percent of map unit: 2 percent Landform: Drainageways on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Myakka** Percent of map unit: 1 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Smyrna** Percent of map unit: 1 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Oldsmar** Percent of map unit: 1 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Wabasso** Percent of map unit: 1 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida (FL097)- Holopaw fine sand: Map Unit Setting Elevation: 20 to 100 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Holopaw and similar soils: 90 percent Minor components: 10 percent **Description of Holopaw Setting** Landform: Flats on marine terraces, drainageways on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Linear Across-slope shape: Linear Parent material: Sandy and loamy marine 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): High (1.98 to 5.95 in/hr) Depth to water table: About 0 to 12 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Low (about 3.4 inches) **Interpretive groups** Land capability (nonirrigated): 4w **Typical profile** 0 to 8 inches: Fine sand 8 to 47 inches: Fine sand 47 to 60 inches: Sandy clay loam 60 to 80 inches: Loamy sand **Minor Components Delray** Percent of map unit: 3 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Malabar** Percent of map unit: 3 percent Landform: Drainageways on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Riviera** Percent of map unit: 2 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Linear Across-slope shape: Linear **Oldsmar** Percent of map unit: 2 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida (FL097)- Immokalee fine sand: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Immokalee and similar soils: 90 percent Minor components: 10 percent **Description of Immokalee Setting** Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear Parent material: Sandy marine 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 (0.57 to 5.95 in/hr) Depth to water table: About 6 to 18 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Low (about 3.6 inches) **Interpretive groups** Land capability (nonirrigated): 4w **Typical profile** 0 to 7 inches: Fine sand 7 to 37 inches: Fine sand 37 to 47 inches: Fine sand 47 to 80 inches: Fine sand **Minor Components Basinger** Percent of map unit: 2 percent

Landform: Drainageways on marine terraces, flats on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Ankona** Percent of map unit: 2 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Myakka** Percent of map unit: 2 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Smyrna** Percent of map unit: 2 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Pomello** Percent of map unit: 2 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida: 19—Malabar fine sand. Map Unit Setting *Elevation:* 10 to 100 feet *Mean annual precipitation:* 44 to 52 inches *Mean annual air temperature:* 70 to 77 degrees F *Frost-free period:* 342 to 365 days **Map Unit Composition** *Malabar and similar soils:* 90 percent *Minor components:* 10 percent **Description of Malabar Setting** *Landform:* Drainageways on marine terraces *Landform position (three-dimensional):* Dip *Down-slope shape:* Linear *Across-slope shape:* Concave *Parent material:* Sandy and loamy marine 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 0.20 in/hr) *Depth to water table:* About 0 to 12 inches *Frequency of flooding:* None *Frequency of ponding:* None *Calcium carbonate, maximum content:* 15 percent *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm) *Sodium adsorption ratio, maximum:* 4.0 *Available water capacity:* Low (about 4.4 inches) **Interpretive groups** *Land capability (nonirrigated):* 4w **Typical profile** *0 to 4 inches:* Fine sand *4 to 18 inches:* Fine sand *18 to 38 inches:* Fine sand *38 to 50 inches:* Fine sand *50 to 61 inches:* Sandy clay loam *61 to 80 inches:* Sandy loam **Minor Components Riviera** *Percent of map unit:* 2 percent *Landform:* Flats on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Linear *Across-slope shape:* Linear **Pompano** *Percent of map unit:* 2 percent *Landform:* Drainageways on marine terraces *Landform position (three-dimensional):* Dip *Down-slope shape:* Linear *Across-slope shape:* Concave **Delray** *Percent of map unit:* 2 percent *Landform:* Depressions on marine terraces *Landform position (three-dimensional):* Dip *Down-slope shape:* Concave *Across-slope shape:* Concave **Pineda** *Percent of map unit:* 2 percent *Landform:* Flats on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Linear *Across-slope shape:* Linear **Winder** *Percent of map unit:* 2 percent *Landform:* Flats on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Concave, linear *Across-slope shape:* Linear

Osceola County, Florida (FL097)- Myakka fine sand: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Myakka and similar soils: 85 percent Minor components: 15 percent **Description of Myakka Setting** Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear Parent material: Sandy marine 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 (0.57 to 5.95 in/hr) Depth to water table: About 6 to 18 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Very low (about 2.9 inches) **Interpretive groups** Land capability (nonirrigated): 4w **Typical profile** 0 to 7 inches: Fine sand 7 to 27 inches: Fine sand 27 to 37 inches: Fine sand 37 to 70 inches: Fine sand 70 to 82 inches: Fine sand **Minor Components Eaugallie** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Immokalee** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Cassia** Percent of map unit: 3 percent Landform: Rises on marine terraces Landform position (three-dimensional): Interfluve, rise Down-slope shape: Convex Across-slope shape: Linear **Smyrna** Percent of map unit: 2 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Pomello** Percent of map unit: 2 percent Landform: Ridges on marine terraces, knolls on marine terraces Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Linear **Ona** Percent of map unit: 2 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida: 26—Oldsmar fine sand. Map Unit Setting *Mean annual precipitation:* 44 to 52 inches *Mean annual air temperature:* 70 to 77 degrees F *Frost-free period:* 342 to 365 days **Map Unit Composition** *Oldsmar and similar soils:* 85 percent *Minor components:* 15 percent **Description of Oldsmar Setting** *Landform:* Flatwoods on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Convex *Across-slope shape:* Linear *Parent material:* Sandy and loamy marine 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 0.20 in/hr) *Depth to water table:* About 6 to 18 inches *Frequency of flooding:* None *Frequency of ponding:* None *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm) *Sodium adsorption ratio, maximum:* 4.0 *Available water capacity:* Low (about 3.9 inches) **Interpretive groups** *Land capability (nonirrigated):* 4w **Typical profile** *0 to 6 inches:* Fine sand *6 to 43 inches:* Fine sand *43 to 63 inches:* Loamy fine sand *63 to 67 inches:* Fine sand *67 to 80 inches:* Sandy clay loam **Minor Components Ankona** *Percent of map unit:* 3 percent *Landform:* Flats on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Convex *Across-slope shape:* Linear **Eaugallie** *Percent of map unit:* 3 percent *Landform:* Flatwoods on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Convex *Across-slope shape:* Linear **Immokalee** *Percent of map unit:* 3 percent *Landform:* Flatwoods on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Convex *Across-slope shape:* Linear **Myakka** *Percent of map unit:* 3 percent *Landform:* Flatwoods on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Convex *Across-slope shape:* Linear **Smyrna** *Percent of map unit:* 3 percent *Landform:* Flats on marine terraces *Landform position (three-dimensional):* Talf *Down-slope shape:* Convex *Across-slope shape:* Linear

Osceola County, Florida (FL097)- Pineda fine sand: Map Unit Setting Elevation: 20 to 100 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Pineda and similar soils: 90 percent Minor components: 10 percent **Description of Pineda Setting** Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Linear Across-slope shape: Linear Parent material: Sandy and loamy marine 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 0.20 in/hr) Depth to water table: About 0 to 12 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Low (about 5.3 inches) **Interpretive groups** Land capability (nonirrigated): 3w **Typical profile** 0 to 6 inches: Fine sand 6 to 28 inches: Fine sand 28 to 60 inches: Sandy clay loam 60 to 80 inches: Sandy loam **Minor Components Floridana** Percent of map unit: 3 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Delray** Percent of map unit: 3 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Riviera** Percent of map unit: 2 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Linear Across-slope shape: Linear **Malabar** Percent of map unit: 2 percent Landform: Drainageways on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave

Osceola County, Florida (FL097)- Placid fine sand, depressional: Map Unit Setting Elevation: 10 to 100 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Placid and similar soils: 85 percent Minor components: 15 percent **Description of Placid Setting** Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave Parent material: Sandy marine 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): High to very high (5.95 to 19.98 in/hr) Depth to water table: About 0 inches Frequency of flooding: None Frequency of ponding: Frequent Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Moderate (about 6.8 inches) **Interpretive groups** Land capability (nonirrigated): 7w **Typical profile** 0 to 24 inches: Fine sand 24 to 80 inches: Fine sand **Minor Components Gentry** Percent of map unit: 3 percent Landform: Flood plains on marine terraces, drainageways on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Basinger, depressional** Percent of map unit: 3 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Delray** Percent of map unit: 3 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Pompano** Percent of map unit: 2 percent Landform: Drainageways on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Samsula** Percent of map unit: 2 percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Ona** Percent of map unit: 2 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida (FL097)- Smyrna fine sand: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Smyrna and similar soils: 85 percent Minor components: 15 percent **Description of Smyrna Setting** Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear Parent material: Sandy marine 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 (0.57 to 5.95 in/hr) Depth to water table: About 6 to 18 inches Frequency of flooding: None Frequency of ponding: None Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Low (about 4.2 inches) **Interpretive groups** Land capability (nonirrigated): 4w **Typical profile** 0 to 7 inches: Fine sand 7 to 14 inches: Fine sand 14 to 25 inches: Fine sand 25 to 56 inches: Fine sand 56 to 80 inches: Fine sand **Minor Components Basinger** Percent of map unit: 3 percent Landform: Drainageways on marine terraces, flats on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Linear Across-slope shape: Concave **Placid** Percent of map unit: 3

percent Landform: Depressions on marine terraces Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave **Eaugallie** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Immokalee** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Myakka** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear

Osceola County, Florida (FL097)- Wabasso fine sand: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 70 to 77 degrees F Frost-free period: 342 to 365 days **Map Unit Composition** Wabasso and similar soils: 88 percent Minor components: 12 percent **Description of Wabasso Setting** Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear Parent material: Sandy and loamy marine 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 0.20 in/hr) Depth to water table: About 6 to 18 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm) Sodium adsorption ratio, maximum: 4.0 Available water capacity: Moderate (about 6.5 inches) **Interpretive groups** Land capability (nonirrigated): 3w **Typical profile** 0 to 10 inches: Fine sand 10 to 21 inches: Fine sand 21 to 28 inches: Fine sand 28 to 32 inches: Fine sandy loam 32 to 62 inches: Sandy clay loam 62 to 80 inches: Sandy clay loam 80 to 98 inches: Fine sandy loam **Minor Components Riviera** Percent of map unit: 3 percent Landform: Flats on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Linear Across-slope shape: Linear **Eaugallie** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Myakka** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear **Wauchula** Percent of map unit: 3 percent Landform: Flatwoods on marine terraces Landform position (three-dimensional): Talf Down-slope shape: Convex Across-slope shape: Linear

4.2.2 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 27). 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 27).

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 27), 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.

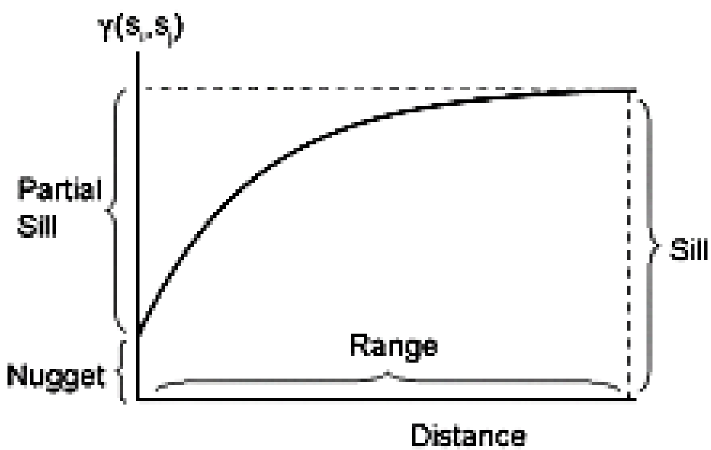


Figure 27. Example semivariogram, depicting range, sill, and nugget.

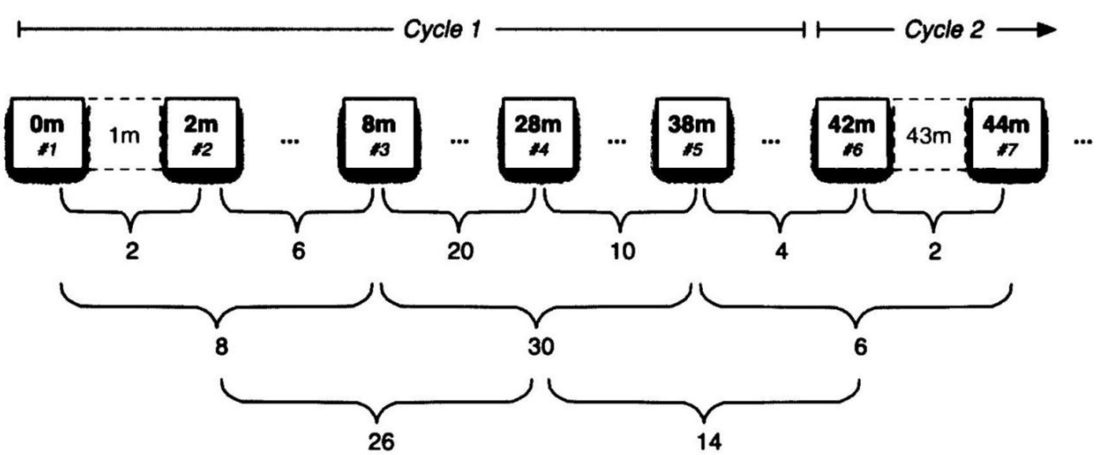


Figure 28. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 23 March 2010 at the Disney site. The sampling points followed the spatially cyclic sampling design by Bond-Lamberty et al. (2006) (Figure 28). Soil temperature and moisture measurements were collected along three transects (210 m, 84 m, and 84 m) located in the expected airshed at Disney. 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 28, 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).

4.2.3 Results and interpretation

4.2.3.1 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 29). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 30, left graphs) and directional semivariograms do not show any indication of anisotropy (Figure 30, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 30, right graph). The model indicates a distance of effective independence of 4 m for soil temperature.

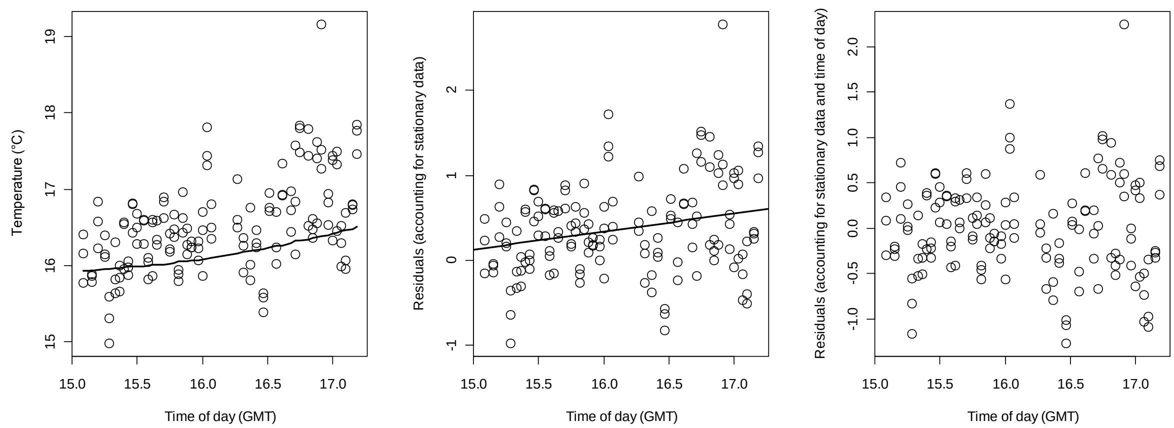


Figure 29. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting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

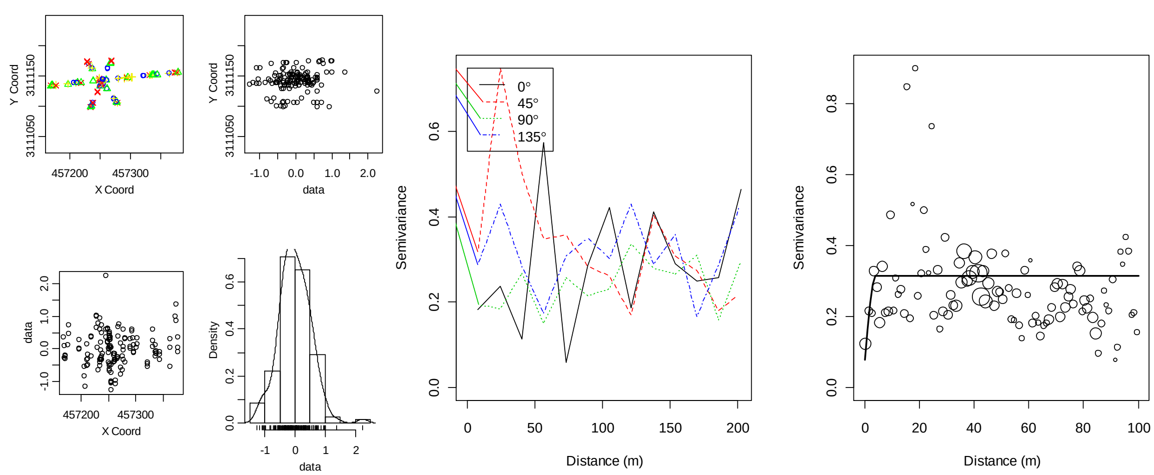


Figure 30. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

4.2.3.2 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 31). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 32, left graph) and directional semivariograms do not show any indication of anisotropy (Figure 32, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights

(Figure 32, right graph). The model indicates a distance of effective independence of 74 m for soil water content.

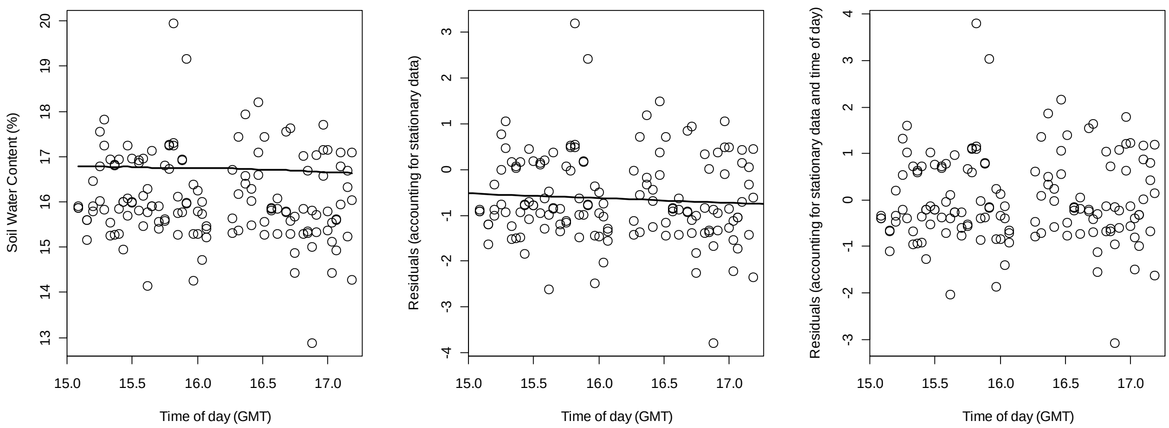


Figure 31. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting 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.

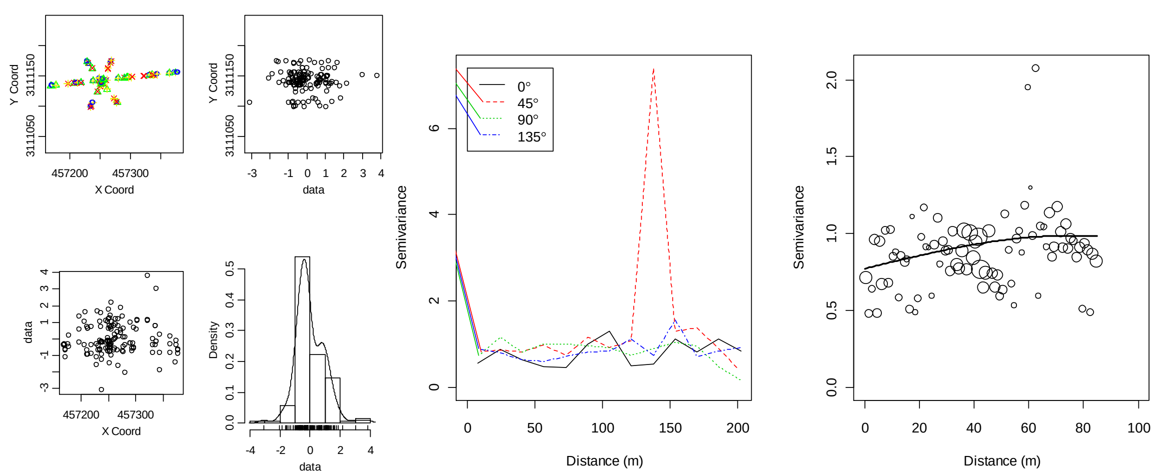


Figure 32. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

4.2.3.3 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 4 m for soil temperature and 74 m for soil moisture. Based on these results and the site design guidelines the soil plots at Disney 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 84° from the soil plot nearest the tower (i.e., first soil plot). The location of the first soil plot will be approximately 28.12506°, -81.43587°. 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 28.124532°, -81.436806° (primary); 28.127846°, -81.434066° (alternative 1); 28.122737°, -81.437852° (alternative 2). A summary of the soil information is shown in Table 11 and site layout can be seen in Figure 33.

Dominant soil series at the site: Smyrna fine sand. The taxonomy of this soil is shown below:
Order: Spodosols
Suborder: Aquods
Great group: Alaquods
Subgroup: Aeric Alaquods
Family: Sandy, siliceous, hyperthermic Aeric Alaquods
Series: Smyrna fine sand

Table 11. Summary of soil array and soil pit information at Disney.
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	33 m
Latitude and longitude of 1st soil plot OR direction from tower	28.12506°, -81.43587°
Direction of soil array	84°
Latitude and longitude of FIU soil pit 1	28.124532°, -81.436806° (primary)
Latitude and longitude of FIU soil pit 2	28.127846°, -81.434066° (alternative 1)
Latitude and longitude of FIU soil pit 3	28.122737°, -81.437852° (alternative 2)
Dominant soil type	Smyrna fine sand
Expected soil depth	>2 m
Depth to water table	0.15-0.46 m

Expected depth of soil horizons	**Expected measurement depths***
0-0.25 m (fine sand)	0.13 m
0.25-0.53 m (fine sand)	0.39 m
0.53-0.71 m (fine sand)	0.62 m

0.71-0.81 m (fine sandy loam)	0.76 m
0.81-1.57 m (sandy clay loam)	1.19 m
1.57-2 m (sandy clay loam)	1.79 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 33. Site layout at Disney showing soil array and location of the FIU soil pit.
Note: The soil pit location is not current. Please see table 11 for current soil pit locations.

4.3 Airshed

4.3.1 Seasonal windroses

Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given timeseries, Figure 34-37. The weather data used to generate the following wind roses are from Kissimmee Airport, FL, which is ~18 km away from Disney Wildness Preserve Relocatable tower site. The orientation of the wind rose follows that of a compass (assume declination applied). When we describe the wind directions it should be noted that they are the cardinal direction that wind blows from. Color bands depict the range of wind speeds. 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.

4.3.2 Results (graphs for wind roses)

General (seasonal) circulation pattern Spring conditions shift toward mesoscale climate dominated by the sub-tropical Hadley cell and the Bermuda High. Weather comes predominately form the S-SE. Strom fronts push the weather patterns toward the E. The short winter circulations are controlled by the temperate Hadley cell, highs originating from the continental US. Storm fronts are often associated on an SW-NE frontal during the winter (From FIU site visit report in 2008).

Similar to Ordway core site, at this site, wind comes from all direction. We selected a direction that has relatively higher frequency as our dominant wind direction to run footprint model. In winter season, we select 40^{o} as model input, but wind comes from all directions, but the high frequency wind ranges from 15^{o} to 165^{o}. In spring, wind mainly comes from southeast (ranges from 45^{o} to 165^{o}) and northwest (ranges from 285^{o} to 345^{o}). In summer, wind comes from all directions: northeast direction (ranges from 15^{o} to 75^{o}), southeast (ranges from 105^{o} to 165^{o}) and southwest (ranges from 225^{o} to 255^{o}). We select 105^{o} as model inputs. In autumn, wind mainly comes from north east direction and ranges from 345^{o} to 165^{o}). But we should keep in mind that wind actually comes from all directions in all seasons, which can be found in the wind roses. Therefore, consider all seasons through the year, wind blows more frequently from 285^{o} to 165^{o} (clockwise from 285^{o}) and from 225^{o} to 255^{o} (clockwise from 225^{o}), among which, airshed from 15^{o} to 165^{o} has the highest frequency in all seasons, and therefore suggest to place FSU plots within this airshed area.

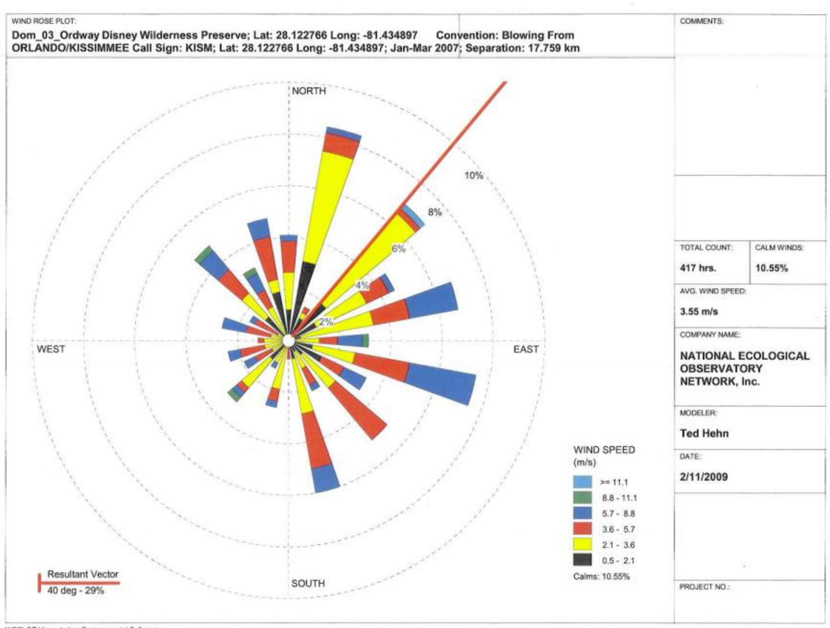


Figure 34. Windroses of January – March for D03 Disney Wildness Preserve Relocatable site.

Note that the lat and long for the airport is not correct. They should be 28.283, -81.433. Same for the next 3 windrose graphs at this site.

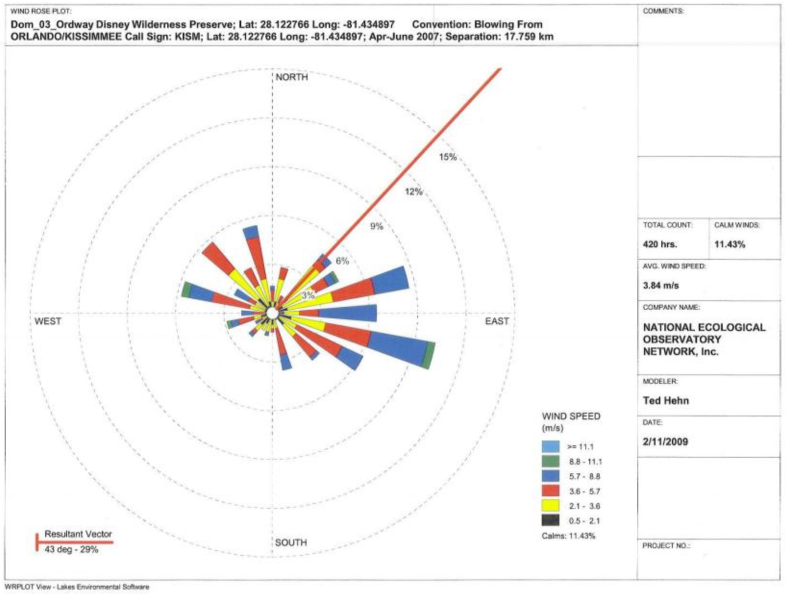


Figure 35. Windroses of April – June for D03 Disney Wildness Preserve Relocatable site.

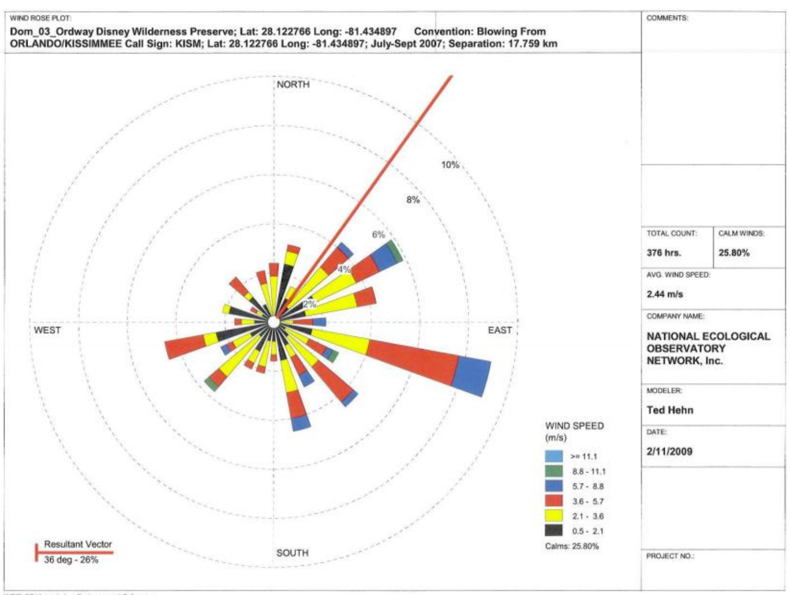


Figure 36. Windroses of July – September for D03 Disney Wildness Preserve Relocatable site.

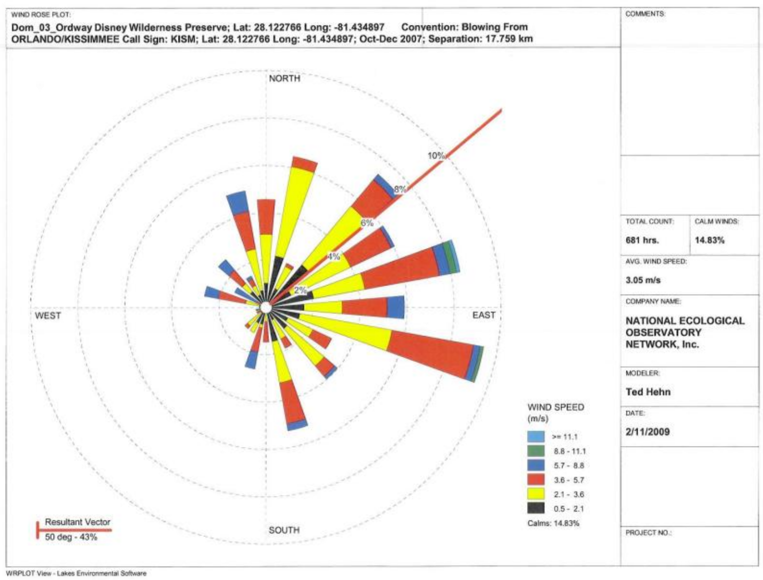


Figure 37. Windroses of October - December for D03 Disney Wildness Preserve Relocatable site.

4.3.3 Resultant vectors

Table 12. The resultant wind vectors for D03 Disney Wildness Preserve Relocatable site.

Quarterly (seasonal) timeperiod	Resultant vector	% duration
January to March	40°	29
April to June	43°	29
July to September	36°	26
October to December	50°	43
Annual mean	42.3°	na.

4.3.4 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, with support from Dr R. Clement, we use a web-based footprint model that programmed by Micrometeorology Group at University of Edinburgh, UK 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 estimates from experienced expert. Measurement height was obtained 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 wind speeds (daytime convective) and nighttime (stable atmospheres) conditions. The wind vector for each run was extracted from wind roses and is placed as a centerline in the site map included in the graphics. The longest distance between the isopleth of 80% cumulative flux and tower, along with the major 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 for Disney Wildness Preserve Relocatable 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	1.5	1.5	1.5	1.5	1.5	1.5	m
Canopy area density	2	2	2	0.5	0.5	0.5	m
Boundary layer depth	2800	2800	1300	900	900	500	m
Expected sensible heat flux	425	425	125	175	175	60	W m^{-2}
Air Temperature	30	30	22	15	15	10	°C
Max. windspeed	8.8	4.5	2.0	11	4.8	2.5	m s^{-1}
Resultant wind vector	105	105	105	75	75	75	degrees
			Results				
(z-d)/L	-0.01	-0.19	-0.49	-0.01	-0.09	-0.16	m
d	1.00	1.00	1.00	1.00	1.00	1.00	m
Sigma v	2.60	2.10	1.10	2.30	1.40	0.79	m^2 s^{-2}
Z0	0.08	0.08	0.08	0.08	0.08	0.08	m
u*	0.87	0.50	0.24	1.10	0.47	0.28	m s^{-1}
Distance source area begins	0	0	0	0	0	0	m
Distance of 90% cumulative flux	500	350	200	600	450	400	m
Distance of 80% cumulative flux	350	200	120	380	250	220	m
Distance of 70% cumulative flux	250	150	80	250	180	150	m
Peak contribution	45	35	25	45	35	35	m

4.3.5 Footprint model results (source area graphs)

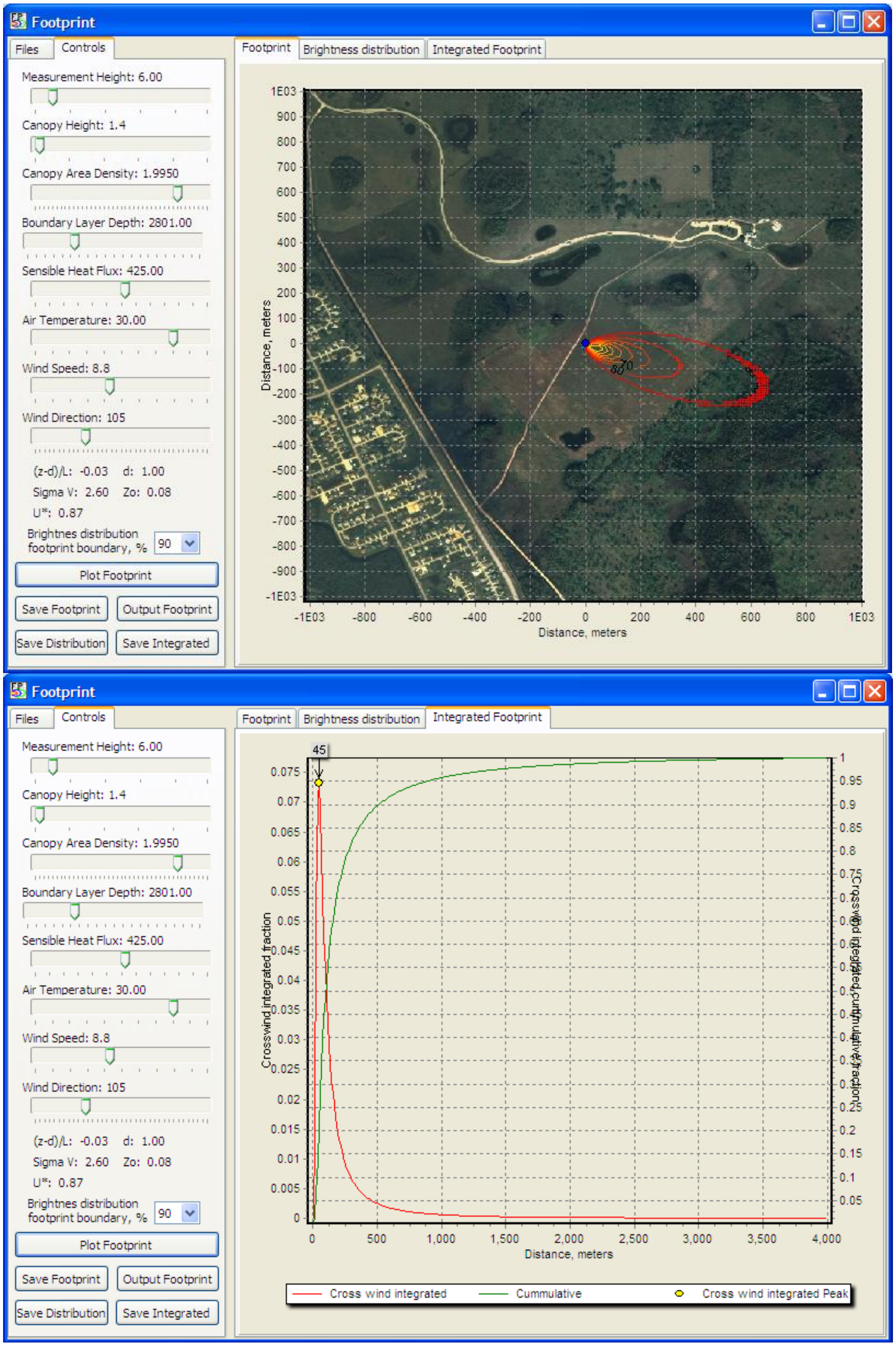


Figure 38. Footprint model output Run 1: summer, daytime, max WS

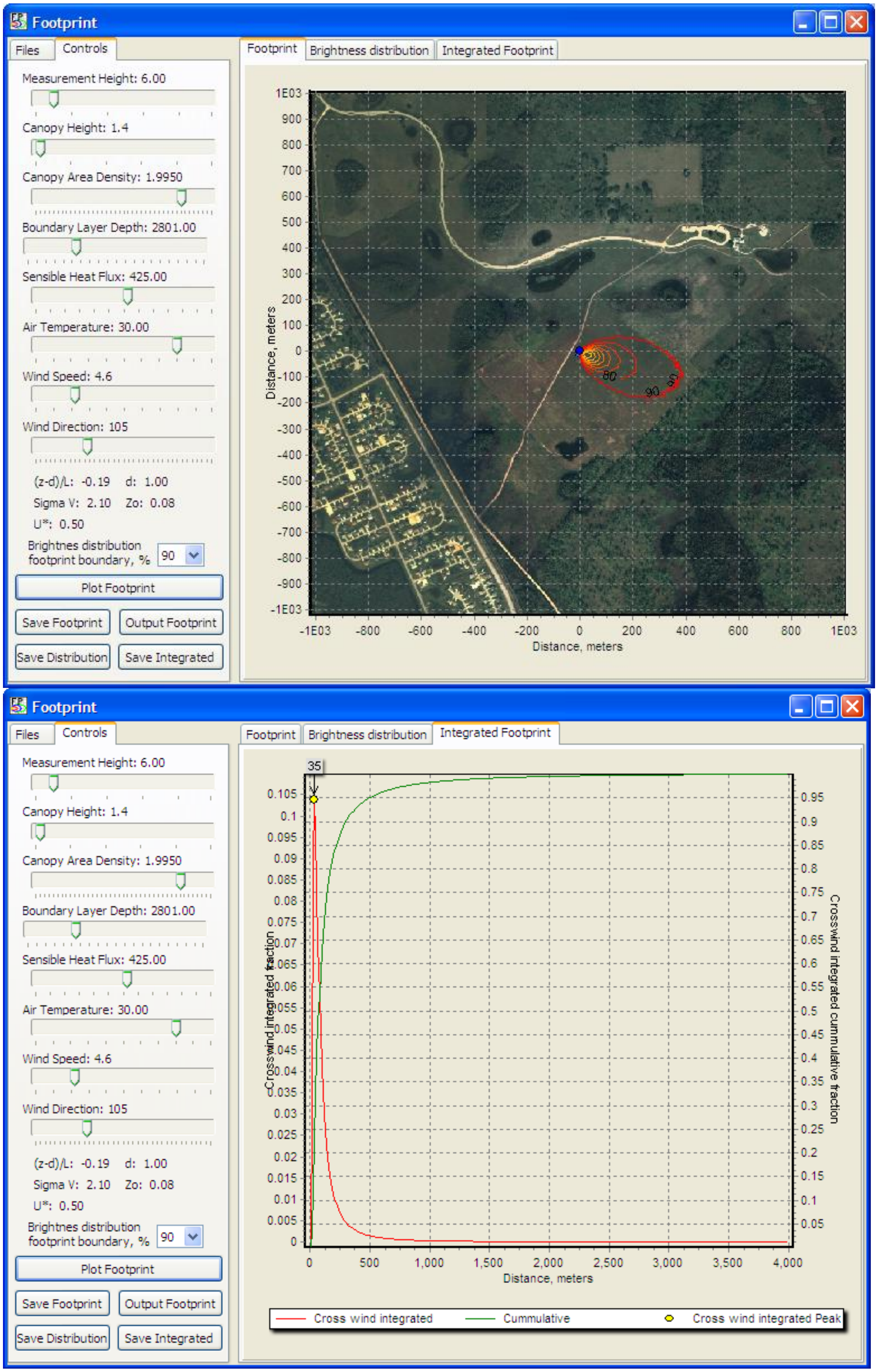


Figure 39. Footprint model output Run 2: summer, daytime, mean WS

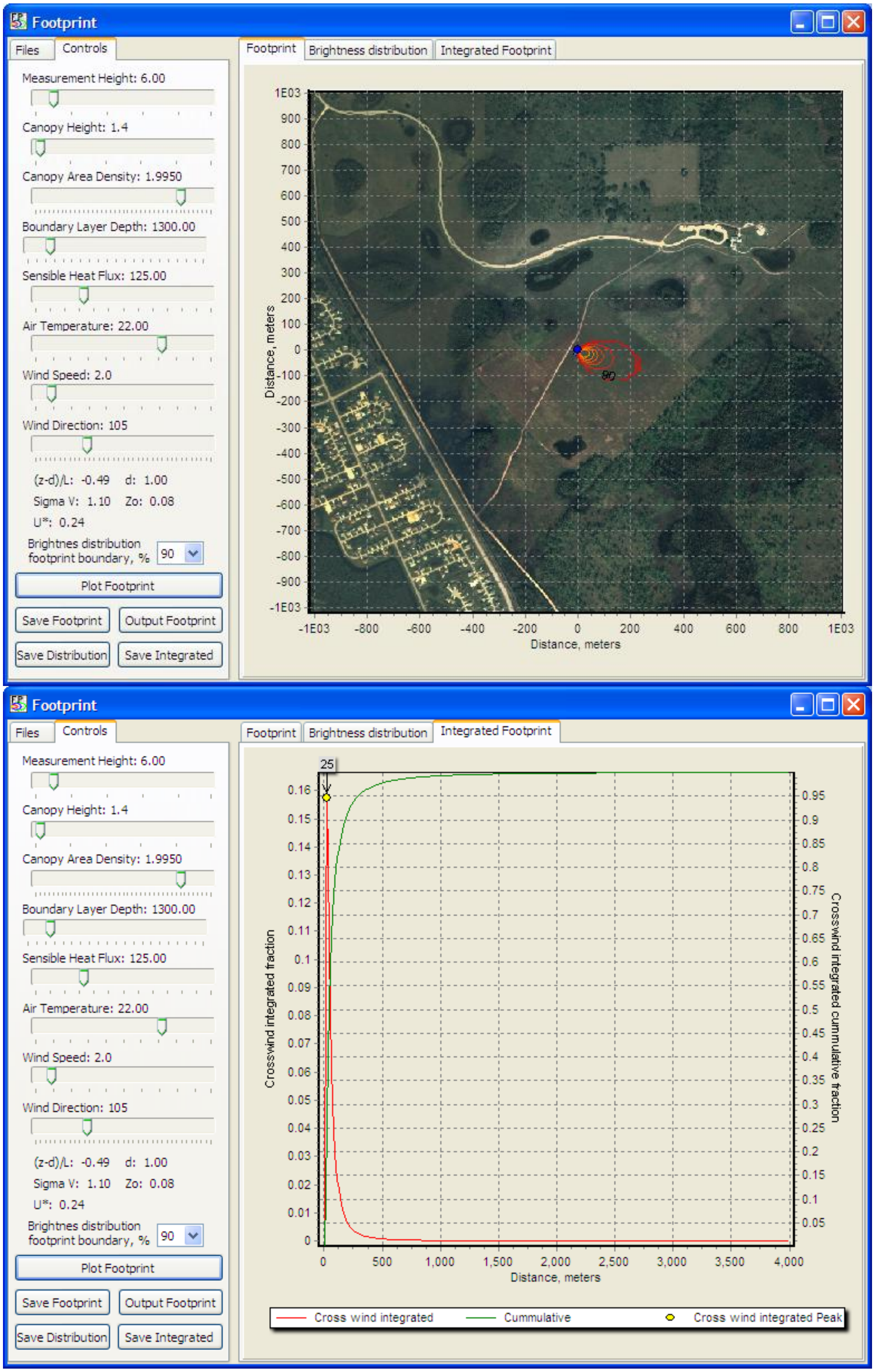


Figure 40. Footprint model output Run 3: summer, nighttime, mean WS

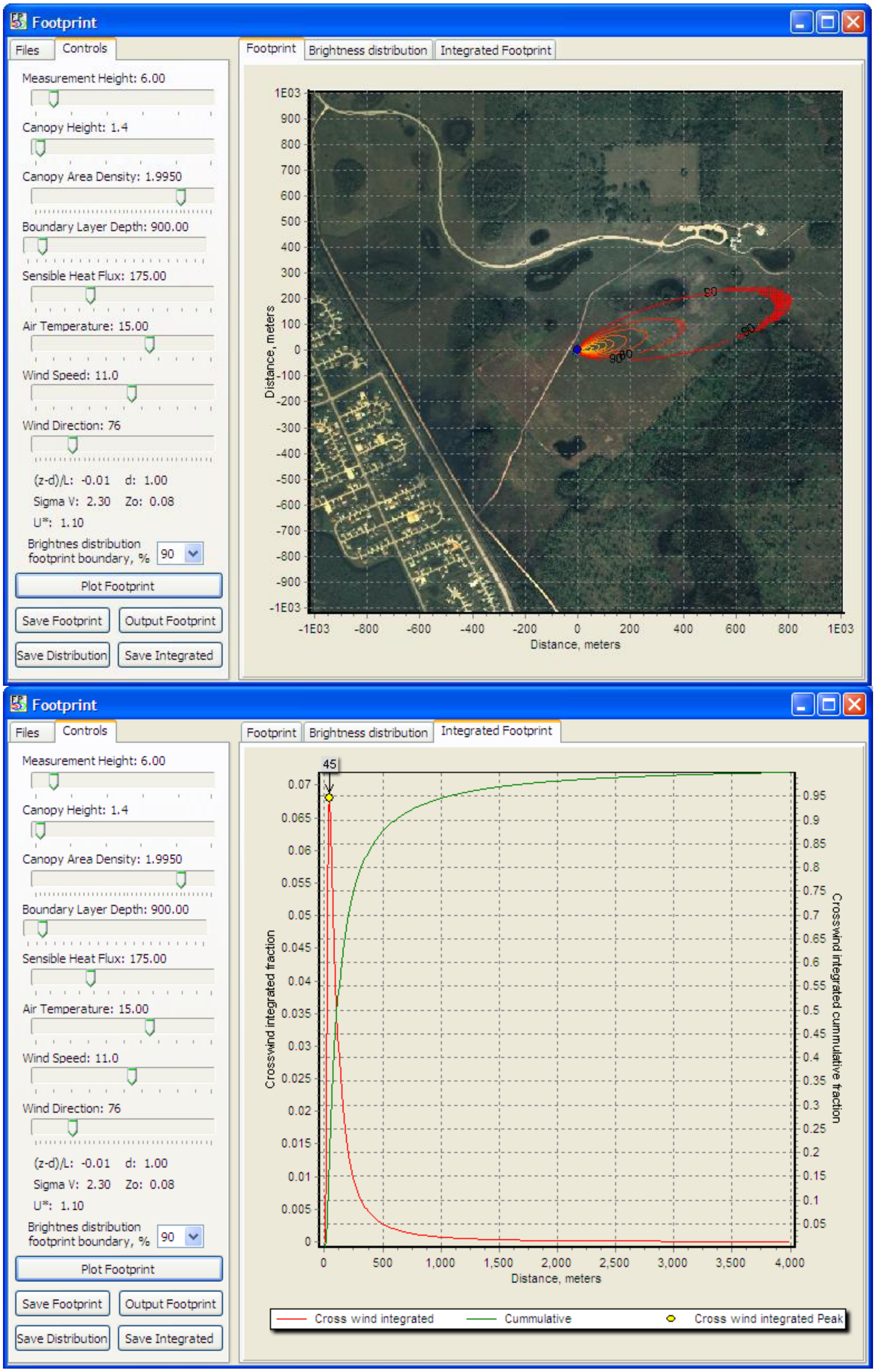


Figure 41. Footprint model output Run 4: winter, daytime, max WS

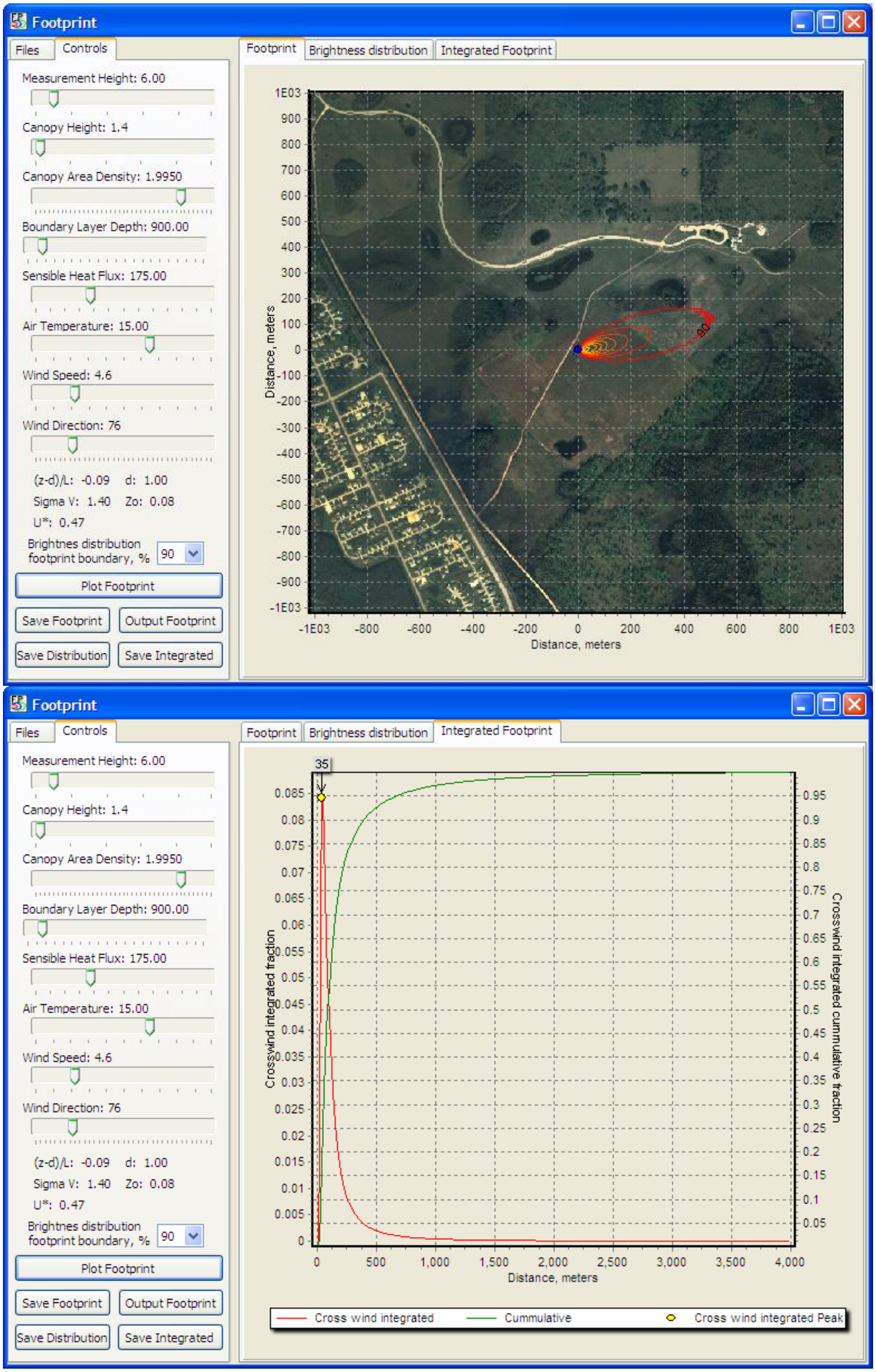


Figure 42. Footprint model output Run 5: winter, daytime, mean WS

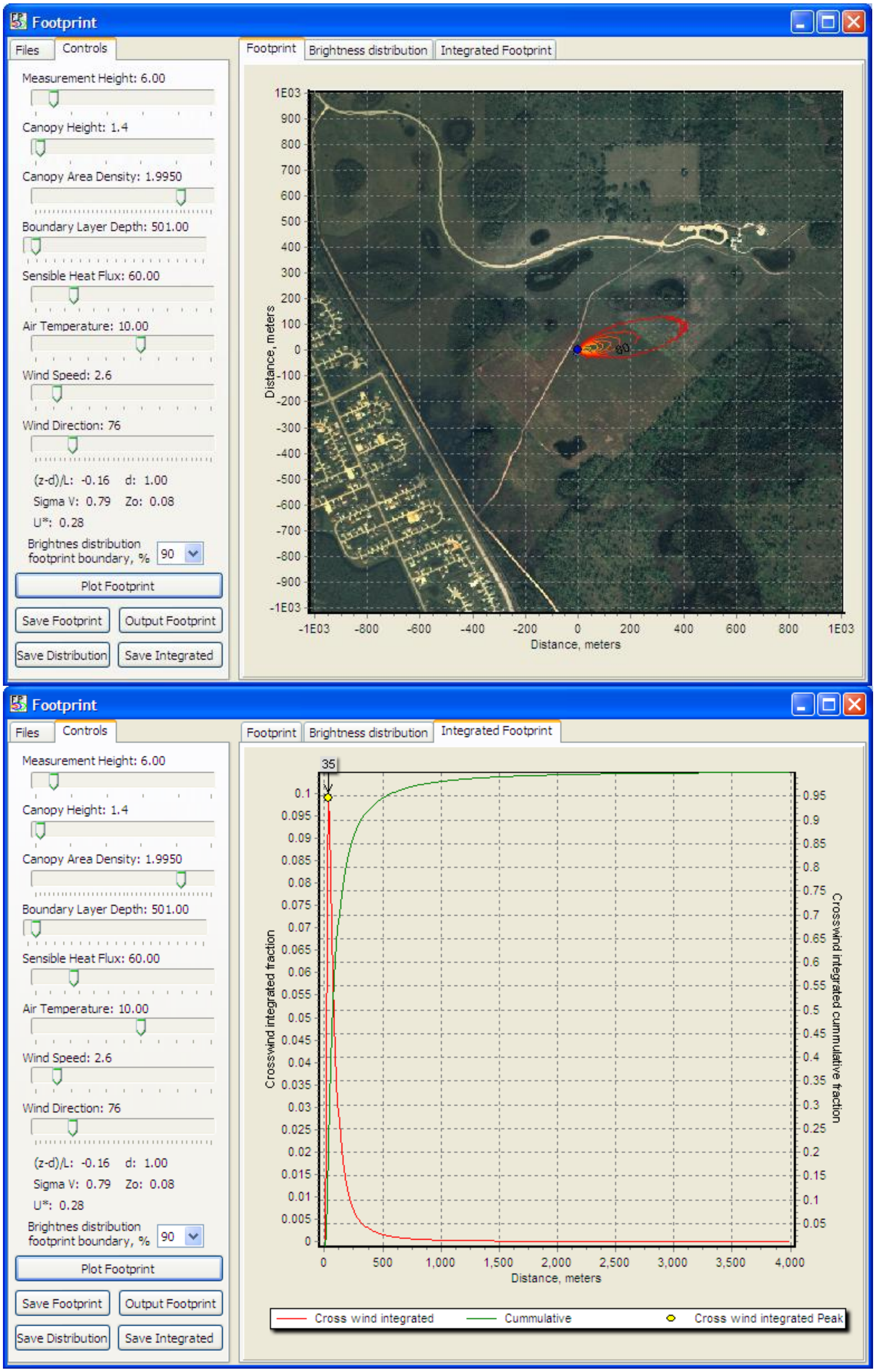


Figure 43. Footprint model output Run 6: winter, nighttime, mean WS

4.3.6 Tower location, instrument hut location, boardwalks, measurement layers on the tower and other sensor locations

Similar to Ordway core site, at this site, wind comes from all direction. In winter season, wind comes from all directions, but the high frequency wind ranges from 15^o to 165^o. In spring, wind mainly comes from southeast (ranges from 45^o to 165^o) and northwest (ranges from 285^o to 345^o). In summer, wind comes from all directions: northeast direction (ranges from 15^o to 75^o), southeast (ranges from 105^o to 165^o) and southwest (ranges from 225^o to 255^o). In autumn, wind mainly comes from north east direction and ranges from 345^o to 165^o). Therefore, consider both all seasons through the year, wind blows more frequently from 285^o to 165^o (clockwise from 285^o) and from 225^o to 255^o (clockwise from 225^o), among which, airshed from 15^o to 165^o has the highest frequency in all seasons, and therefore suggest to place FSU plots within this airshed area.

The footprint is ~400 m for 80% cumulative flux measurement. The tower should be positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (Broom sedge prairie in this case). The original tower site was lat 28.122766°, long -81.434897°, after FIU site characterization, we determine the exact tower location to be at 28.12504°, -81.43620°. New location is about 280 m northwest of original tower location and closer to access road. Eddy covariance, sonic wind and temperature boom arms orientation toward East will maximize the quality wind and air signals from all major wind directions. Radiation boom arms should always be facing the South to avoid any shadowing effects from the tower structure. Instrument hut is 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

This site is Broom sedge prairie. Canopy height is ~ 1.0 to 1.5 m around tower site and in the airshed area. We suggest 4 measurement layers on the tower with top measurement height at 6 m, and rest layers are 3.5 m, 1.5 m, and 0.8 m, respectively.

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 conduit 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.

- There is always a boardwalk from the instrument hut to the tower
- There is never a boardwalk on the south side of the tower
- There is never a boardwalk within 4 m of the tower, except where it perpendicularly intersects the tower for access
- The boardwalk the access to the tower is not on any side that has a boom.

- There is never boardwalk within 10 m of a soil plot, except where it perpendicularly intersects a soil plot for access.

Specific Boardwalks at Disney Wilderness preserve

- Boardwalk from access road to instrument hut (from the west)
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower,
- Boardwalk to the soil array
- Boardwalks must be protected from controlled burns
- No boardwalk from the soil array boardwalk to the individual soil plots

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 14. Tower oriented design attributes for the Disney 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			15° to 165°		Clockwise from 15°
Tower location	28.12504	-81.43620	--	--	new site
Instrument hut	28.12514	-81.43645			
Instrument hut (perpendicular) orientation vector	--	--	90° to 270°		Shorter side parallel to 180° to 360°
Instrument hut distance z	--	--	--	25	
Anemometer/Temperature boom orientation	--	--	90°	--	From tower point to this direction
Height of the measurement levels					
Level 1				0.3	m.a.g.l.
Level 2				1.5	m.a.g.l.
Level 3				4.0	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 44 below shows the proposed tower location, instrument hut location, airshed area and access road.

Figure 44. Plan view of D03 Disney Wildness Preserve Relocatable site location.

i) new tower location is presented, ii) red lines indicate the airshed boundaries. Vectors 15° and 165° (starting clockwise from 15°) bound the airshed, within which it would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut. iv) White line indicates soil array. Note: soil pit location is not current. See Table 11 for current soil pits locations.

Keep in mind that all **radiation sensors** above canopy need to be mounted on the south side of the tower to avoid shadow from tower structure and mounting parts.

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

4.3.7 Information for ecosystem productivity plots

The tower at Disney Wildness Preserve Relocatable site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (Broom sedge prairie). Wind vectors from the tower dictate the major airshed is from 15^o to 165^o (clockwise from 15^o, this is major airshed area). But wind comes from all directions at this site. Secondary airshed include 285^o to 15^o (clockwise from 15^o) and from 225^o to 255^o (clockwise from 225^o), and 80% signals for flux measurements are within a distance of 380 m from tower. We recommend that the FSU Ecosystem Productivity plots should be placed within the airshed boundaries of the 15 degrees line and the 165 degree line (clockwise from 15^o, major airshed area).

5 JONES (RELOCATABLE TOWER SITE 2)

5.1 Site Description

The Jones Ecological Research Center is located in Baker county, southwest Georgia and covers 29,000 acres (Figure 45). It is a large upland pine/hardwood site set in a mixed land use matrix. The ecological questions for D03 revolve around the drivers and processes associated with restored ecosystems. In this case, the Jones Center site will be removing oak-encroached systems and restoring the nature stand density and fire regime that supports native Longleaf Pine and wiregrass plant communities.

The research center was initially established as a hunting reserve in the 1920s. Previous research at this center has focused on the ecology and management of longleaf pine woodlands and wetland/aquatic resources.

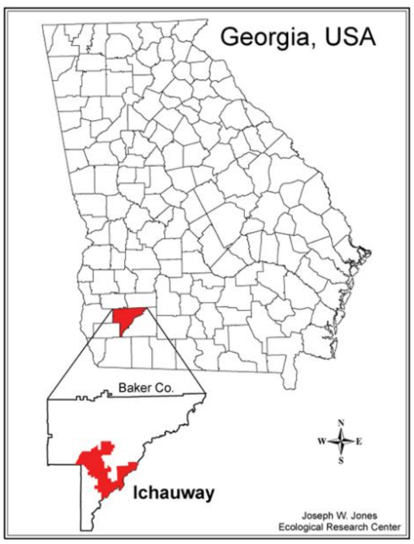


Figure 45. Location of the Jones Ecological Research Center site.

5.1.1 Ecosystem

The research center is comprised of extensive longleaf pine forests, slash pine forests, old field loblolly pine stands, mixed pine hardwoods, riparian hardwood forests, live oak depressions, isolated depressional wetlands, creek swamps, agricultural fields, shrub-scrub uplands, human cultural zones, and rivers and creeks. Mean canopy height is between 10 m and 25 m.

The longleaf pine-wiregrass forests at the Jones Center are second-growth stands with the average tree ages ranging from 70-90 years (Mitchell *et al.* 1998). Soils include Typic Quartzipsament (characterized by coarse sand that exceeds 2.5 m in depth, weak development of soil horizons due to mixing by soil fauna, low organic matter content, and lack of silt and clay) and Aquic Arenic Paleudult (characterized by a heavy textured subsurface horizon, evidence of poor drainage (mottling) within the 0-30 cm horizon, and standing water on the surface after significant rainfall events in the winter months) (Mitchell *et al.* 1998). Fire acts as an important disturbance in this ecosystem.

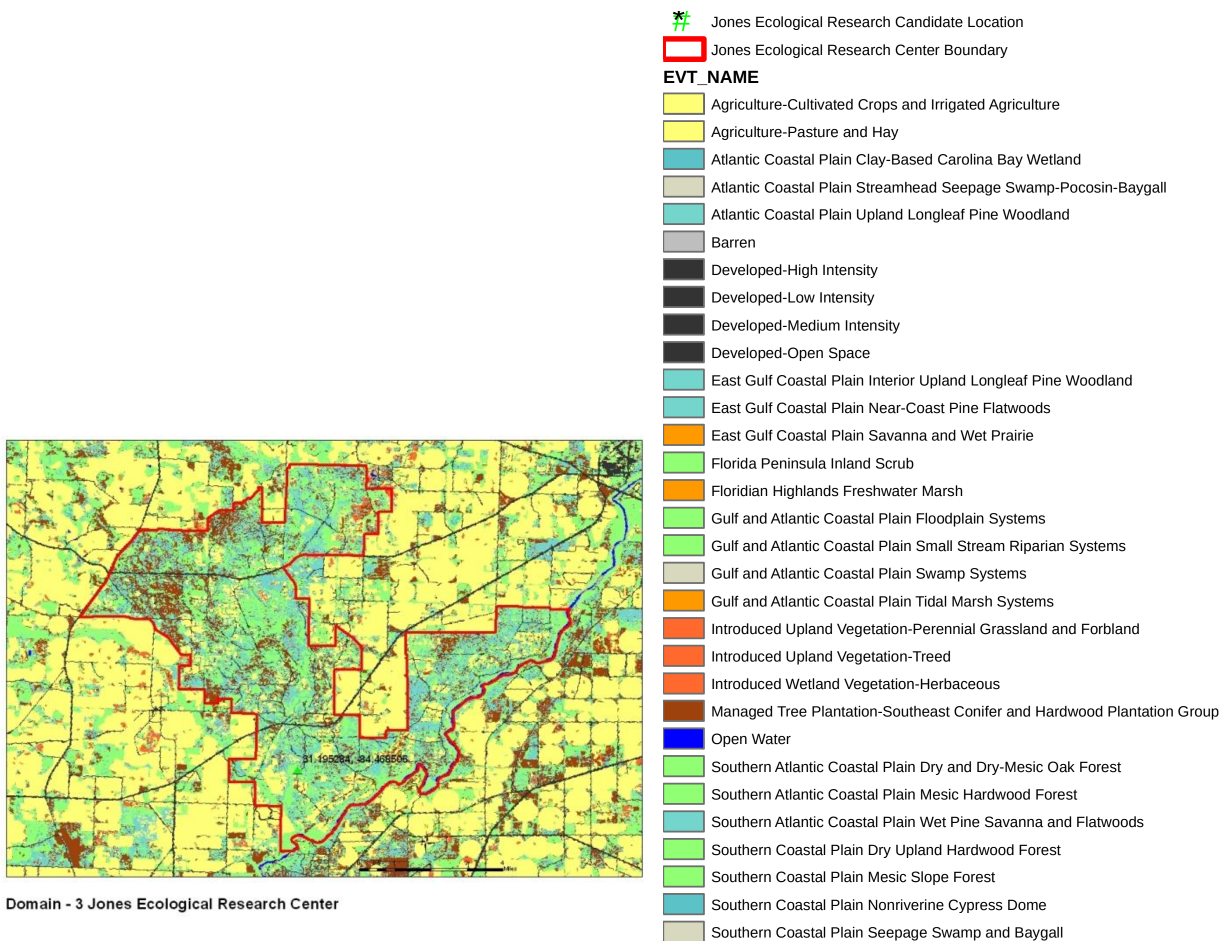


Figure 46. Vegetation map for Jones NEON relocatable tower site 2 and surrounding area (information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm).

Table 15. Percent Land cover type at Jones
(information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm)

Veg_Type	Area (km^2)	%
Agriculture-Cultivated Crops and Irrigated Agriculture	8.03	6.85
Agriculture-Pasture and Hay	7.33	6.25
Atlantic Coastal Plain Clay-Based Carolina Bay Wetland	0.94	0.80
Atlantic Coastal Plain Streamhead Seepage Swamp-Pocosin-Baygall	0.05	0.04
Atlantic Coastal Plain Upland Longleaf Pine Woodland	0.05	0.04
Developed-Low Intensity	0.12	0.10
Developed-Medium Intensity	0.01	0.01
Developed-Open Space	5.05	4.30
East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland	35.41	30.19
Florida Peninsula Inland Scrub	0.02	0.01
Floridian Highlands Freshwater Marsh	0.00	0.00
Gulf and Atlantic Coastal Plain Floodplain Systems	1.05	0.89
Gulf and Atlantic Coastal Plain Small Stream Riparian Systems	4.25	3.63
Gulf and Atlantic Coastal Plain Swamp Systems	1.26	1.08
Gulf and Atlantic Coastal Plain Tidal Marsh Systems	0.01	0.01
Introduced Upland Vegetation-Perennial Grassland and Forbland	1.55	1.32
Introduced Wetland Vegetation-Herbaceous	0.32	0.27
Managed Tree Plantation-Southeast Conifer and Hardwood Plantation Group	17.19	14.65
Open Water	1.12	0.96
Southern Atlantic Coastal Plain Dry and Dry-Mesic Oak Forest	0.00	0.00
Southern Atlantic Coastal Plain Mesic Hardwood Forest	0.01	0.01
Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods	0.07	0.06
Southern Coastal Plain Dry Upland Hardwood Forest	33.17	28.27
Southern Coastal Plain Nonriverine Cypress Dome	0.08	0.07
Southern Coastal Plain Seepage Swamp and Baygall	0.21	0.18
Total	**117.31**	**100.00**

The ecosystem we are interested in is the managed restored longleaf pine forest. The vegetation at NEON site is dominant by longleaf pine trees, mixed with some hardwood deciduous (e.g. oak). All hardwood trees will be removed within 2-3 years after the establishment of NEON tower. Hardwood resprouts and seedlings will be controlled by mechanical, chemical and fire treatment. Controlled burn has been and will be done once every 2 years. Pine buds can normally survive through the fire. Fire ant colonies are very common here.

Mature pine tree canopy is open. The recruit young pine trees are dense and distribute patchily at forest gaps, but didn't form layers. Understory includes wiregrass and other annuals and short perennial shrub. Tree height around tower is ~27 m with lowest branch ~14 m. Young pine trees vary from ~3 m to ~20 m. Understory height varies from 0.4 m for wiregrass to 1 m for short perennials.

The ecosystem attributes to this site are summarized as following:

Table 16. Ecosystem and site attributes the Jones Ecological Research Center Relocatable site.

Ecosystem attributes	Measure and units
Mean canopy height[a]	27 m
Surface roughness[a]	1.2 m
Zero place displacement height[a]	22 m
Structural elements	Semi-open forest, relatively homogeneous
Altitude[b]	15-91 [m] a.s.l.
Slope	0%
Aspect	± 0
Time zone	Atlantic
Magnetic declination	4° 1' W
Frost-free period	365 days

Note, [a] From footprint analysis below.
[b] http://www.jonesctr.org/research/research_publications/Unrestricted/BattleAmerMidlandNatur150P15.pdf

5.2 Soils

5.2.1 Soil Description

Soil data and soil maps (Figures 47) below for Jones relocatable tower site 2 were collected from 2.4 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 47. 2.4 km^2 soil map for Jones relocatable site 2, center at tower location.

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 2.4 km^2 centered on the tower.
Area Object Interest (AOI) is the mapping unit from NRCS

	Baker and Mitchell Counties, Georgia (GA603)		
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AdA	Albany sand, 0 to 2 percent slopes	16.2	2.70%
BgA	Bigbee sand, 0 to 2 percent slopes	8.9	1.50%
DpA	Duplin fine sandy loam, 0 to 2 percent slopes	0.9	0.20%
HvA	Hornsville fine sandy loam, 0 to 2 percent slopes	40.3	6.60%
KeC	Kershaw sand, 2 to 12 percent slopes	30.6	5.00%
LmB	Lucy loamy sand, 0 to 5 percent slopes	48.1	7.90%
NoA	Norfolk loamy sand, 0 to 2 percent slopes	22.1	3.60%
OeA	Orangeburg loamy sand, 0 to 2 percent slopes	22.2	3.70%
OeB	Orangeburg loamy sand, 2 to 5 percent slopes	2	0.30%
OeC	Orangeburg loamy sand, 5 to 8 percent slopes	6.9	1.10%
Pe	Pelham loamy sand	6.7	1.10%
SuA	Suffolk loamy fine sand, 0 to 2 percent slopes	3.1	0.50%
TwB	Troup sand, 0 to 5 percent slopes	284.1	46.80%
TwC	Troup sand, 5 to 8 percent slopes	29.9	4.90%
W	Water	11.3	1.90%
WaB	Wagram loamy sand, 0 to 5 percent slopes	73.9	12.20%
Total		**607.3**	**100.00%**

Note, asterisk indicates dominant soil type(s) in airshed

Baker and Mitchell Counties, Georgia (GA603)- Albany sand, 0 to 2 percent slopes: Map Unit Setting Elevation: 20 to 450 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Albany and similar soils: 95 percent Pelham and similar soils: 5 percent **Description of Albany Setting** Landform: Flats Landform position (three-dimensional): Talf Down-slope shape: Linear Across-slope shape: Linear Parent material: Marine 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 1.98 in/hr) Depth to water table: About 12 to 30 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Very low (about 2.2 inches) **Interpretive groups** Land capability (nonirrigated): 3w **Typical profile** 0 to 53 inches: Sand 53 to 64 inches: Sandy loam 64 to 80 inches: Sandy clay loam **Description of Pelham Setting** Landform: Depressions Down-slope shape: Concave Across-slope shape: Concave Parent material: Marine 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 (0.57 to 1.98 in/hr) Depth to water table: About 0 to 12 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 6.1 inches) **Interpretive groups** Land capability (nonirrigated): 5w **Typical profile** 0 to 22 inches: Loamy sand 22 to 72 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Bigbee sand, 0 to 2 percent slopes: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Bigbee and similar soils: 100 percent **Description of Bigbee Setting** Landform: Stream terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Excessively drained Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr) Depth to water table: About 42 to 72 inches Frequency of flooding: Occasional Frequency of ponding: None Avilable water capacity: Low (about 4.3 inches) **Interpretive groups** Land capability (nonirrigated): 3s **Typical profile** 0 to 8 inches: Sand 8 to 96 inches: Sand

Baker and Mitchell Counties, Georgia (GA603)- Duplin fine sandy loam, 0 to 2 percent slopes: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Duplin and similar soils: 100 percent **Description of Duplin Setting** Landform: Flats Landform position (three-dimensional): Talf Down-slope shape: Linear Across-slope shape: Linear Parent material: Marine 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 (0.20 to 0.57 in/hr) Depth to water table: About 24 to 36 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 9.2 inches) **Interpretive groups** Land capability (nonirrigated): 2w **Typical profile** 0 to 12 inches: Fine sandy loam 12 to 62 inches: Sandy clay

Baker and Mitchell Counties, Georgia (GA603)- Hornsville fine sandy loam, 0 to 2 percent slopes: Map Unit Setting Elevation: 50 to 200 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Hornsville and similar soils: 100 percent **Description of Hornsville Setting** Landform: Stream terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium **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 (0.20 to 0.57 in/hr) Depth to water table: About 30 to 42 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.6 inches) **Interpretive groups** Land capability (nonirrigated): 2w **Typical profile** 0 to 11 inches: Fine sandy loam 11 to 43 inches: Sandy clay 43 to 62 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Kershaw sand, 2 to 12 percent slopes: Map Unit Setting Elevation: 40 to 500 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Kershaw and similar soils: 100 percent **Description of Kershaw Setting** Landform: Hills Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Marine deposits **Properties and qualities** Slope: 2 to 12 percent Depth to restrictive feature: More than 80 inches Drainage class: Excessively drained Capacity of the most limiting layer to transmit water (Ksat): Very high (19.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Very low (about 2.4 inches) **Interpretive groups** Land capability (nonirrigated): 7s **Typical profile** 0 to 72 inches: Sand

Baker and Mitchell Counties, Georgia (GA603)- Lucy loamy sand, 0 to 5 percent slopes: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Lucy and similar soils: 100 percent **Description of Lucy Setting** Landform: Hills Landform position (two-dimensional): Backslope, shoulder, summit Landform position (three-dimensional): Interfluve, side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Marine deposits **Properties and qualities** Slope: 0 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): 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): 2s **Typical profile** 0 to 29 inches: Loamy sand 29 to 72 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Norfolk loamy sand, 0 to 2 percent slopes: Map Unit Setting Elevation: 30 to 450 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Norfolk and similar soils: 100 percent **Description of Norfolk Setting** Landform: Interfluves Down-slope shape: Convex Across-slope shape: Linear Parent material: Marine deposits **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr) Depth to water table: About 48 to 72 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.9 inches) **Interpretive groups** Land capability (nonirrigated): 1 **Typical profile** 0 to 10 inches: Loamy sand 10 to 72 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Orangeburg loamy sand, 0 to 2 percent slopes: Map Unit Setting Elevation: 170 to 500 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Orangeburg and similar soils: 100 percent **Description of Orangeburg Setting** Landform: Interfluves Down-slope shape: Convex Across-slope shape: Linear Parent material: Marine deposits **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 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 7.1 inches) **Interpretive groups** Land capability (nonirrigated): 1 **Typical profile** 0 to 13 inches: Loamy sand 13 to 16 inches: Sandy loam 16 to 72 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Orangeburg loamy sand, 2 to 5 percent slopes: Map Unit Setting Elevation: 170 to 500 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Orangeburg and similar soils: 100 percent **Description of Orangeburg Setting** Landform: Interfluves Down-slope shape: Convex Across-slope shape: Linear Parent material: Marine 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 (0.57 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 7.1 inches) **Interpretive groups** Land capability (nonirrigated): 2e **Typical profile** 0 to 13 inches: Loamy sand 13 to 16 inches: Sandy loam 16 to 72 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Orangeburg loamy sand, 5 to 8 percent slopes: Map Unit Setting Elevation: 170 to 500 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Orangeburg and similar soils: 100 percent **Description of Orangeburg Setting** Landform: Hills Landform position (two-dimensional): Backslope, shoulder Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Marine deposits **Properties and qualities** Slope: 5 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 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 7.1 inches) **Interpretive groups** Land capability (nonirrigated): 3e **Typical profile** 0 to 13 inches: Loamy sand 13 to 16 inches: Sandy loam16 to 72 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Pelham loamy sand: Map Unit Setting Elevation: 20 to 450 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Pelham and similar soils: 100 percent **Description of Pelham Setting** Landform: Depressions, drainageways, flats Landform position (three-dimensional): Talf Down-slope shape: Concave, linear Across-slope shape: Concave, linear Parent material: Marine 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 (0.57 to 1.98 in/hr) Depth to water table: About 0 to 12 inches Frequency of flooding: Occasional Frequency of ponding: None Available water capacity: Moderate (about 6.1 inches) **Interpretive groups** Land capability (nonirrigated): 5w **Typical profile** 0 to 22 inches: Loamy sand 22 to 72 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Suffolk loamy fine sand, 0 to 2 percent slopes: Map Unit Setting Elevation: 30 to 150 feet Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Suffolk and similar soils: 100 percent **Description of Suffolk Setting** Landform: Interfluves Down-slope shape: Convex Across-slope shape: Linear Parent material: Marine deposits **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 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 6.1 inches) **Interpretive groups** Land capability (nonirrigated): 1 **Typical profile** 0 to 17 inches: Loamy fine sand 17 to 46 inches: Sandy clay loam 46 to 72 inches: Loamy sand

Baker and Mitchell Counties, Georgia (GA603)- Troup sand, 0 to 5 percent slopes: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Troup and similar soils: 100 percent **Description of Troup Setting** Landform: Interfluves Down-slope shape: Convex Across-slope shape: Linear Parent material: Marine deposits **Properties and qualities** Slope: 0 to 5 percent Depth to restrictive feature: More than 80 inches Drainage class: Somewhat excessively 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: Low (about 5.1 inches) **Interpretive groups** Land capability (nonirrigated): 3s **Typical profile** 0 to 53 inches: Sand 53 to 82 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Troup sand, 5 to 8 percent slopes: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Troup and similar soils: 100 percent **Description of Troup Setting** Landform: Hills Landform position (two-dimensional): Backslope, shoulder Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Marine deposits **Properties and qualities** Slope: 5 to 8 percent Depth to restrictive feature: More than 80 inches Drainage class: Somewhat excessively 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: Low (about 5.1 inches) **Interpretive groups** Land capability (nonirrigated): 4s **Typical profile** 0 to 53 inches: Sand 53 to 82 inches: Sandy clay loam

Baker and Mitchell Counties, Georgia (GA603)- Wagram loamy sand, 0 to 5 percent slopes: Map Unit Setting Mean annual precipitation: 44 to 52 inches Mean annual air temperature: 63 to 70 degrees F Frost-free period: 230 to 260 days **Map Unit Composition** Wagram and similar soils: 70 percent **Description of Wagram Setting** Landform: Interfluves Down-slope shape: Convex Across-slope shape: Linear Parent material: Marine deposits **Properties and qualities** Slope: 0 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 (0.57 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 6.4 inches) **Interpretive groups** Land capability (nonirrigated): 2s **Typical profile** 0 to 6 inches: Loamy sand 6 to 28 inches: Loamy sand 28 to 65 inches: Sandy loam

Baker and Mitchell Counties, Georgia (GA603)-Water: Map Unit Setting Mean annual precipitation: 52 to 68 inches Mean annual air temperature: 54 to 59 degrees F Frost-free period: 160 to 210 days **Map Unit Composition** Water: 100 percent

5.2.2 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 48). 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 48).

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 48), 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.

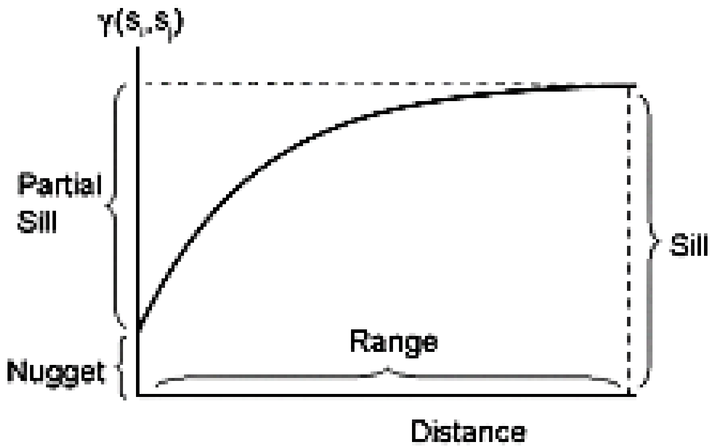


Figure 48. Example semivariogram, depicting range, sill, and nugget.

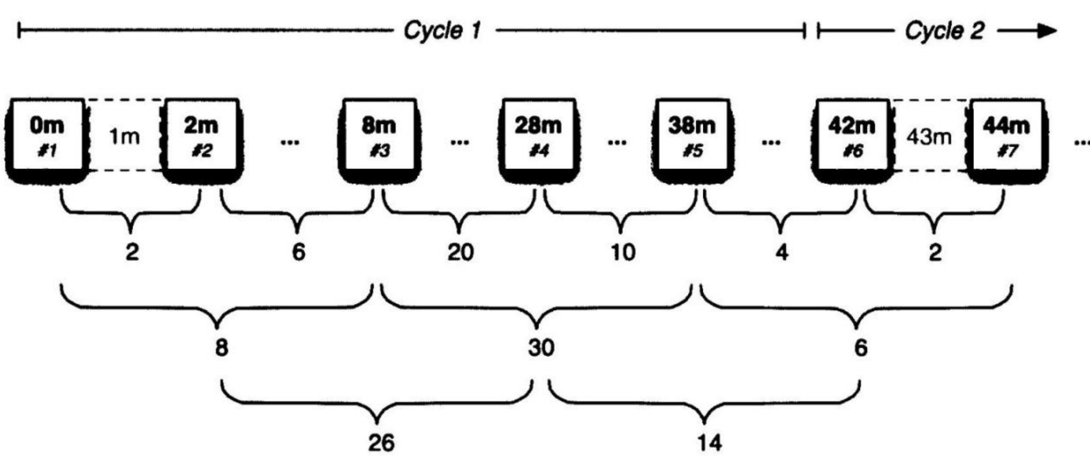


Figure 49. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 21 March 2010 at the Jones site. The sampling points followed the spatially cyclic sampling design by Bond-Lamberty et al. (2006) (Figure 49). Soil temperature and moisture measurements were collected along three transects (210 m, 84 m, and 84 m) located in the expected airshed at Jones. 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 49, 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).

5.2.3 Results and interpretation

5.2.3.1 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 50). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 51, left graphs) and directional semivariograms do not show any indication of anisotropy (Figure 51, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 51, right graph). The model indicates a distance of effective independence of 35 m for soil temperature.

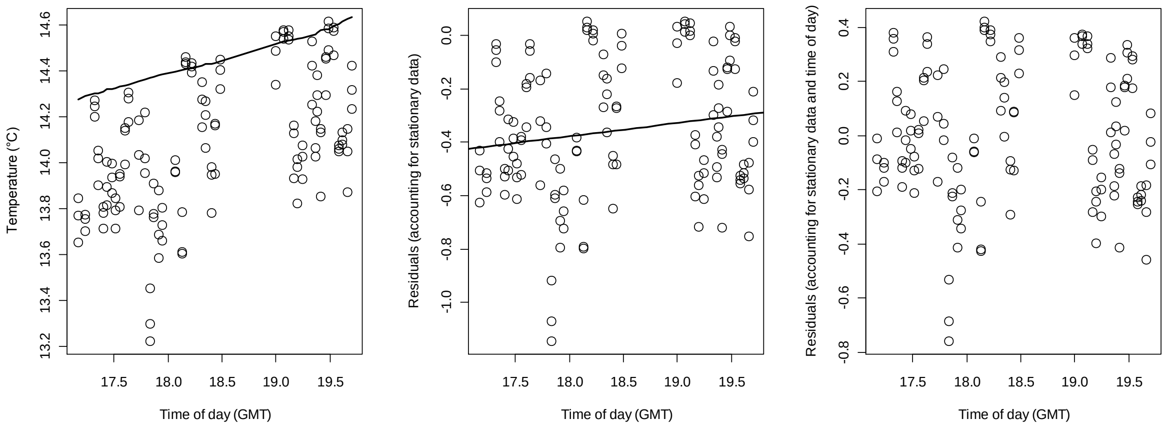


Figure 50. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting for changes temperature in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

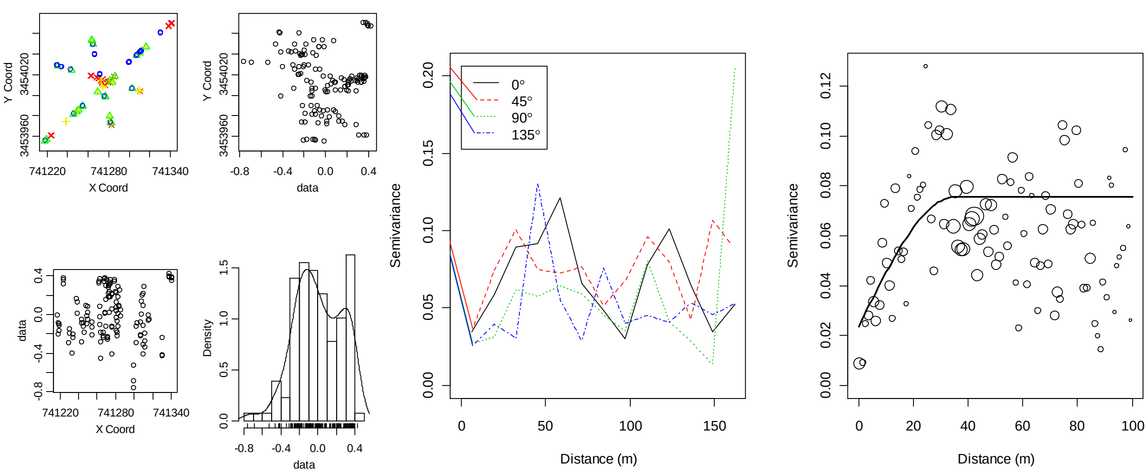


Figure 51. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

5.2.3.2 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 52). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 53, left graph) and directional semivariograms do not show any indication of anisotropy (Figure 53, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights

(Figure 53, right graph). The model indicates a distance of effective independence of 8 m for soil water content.

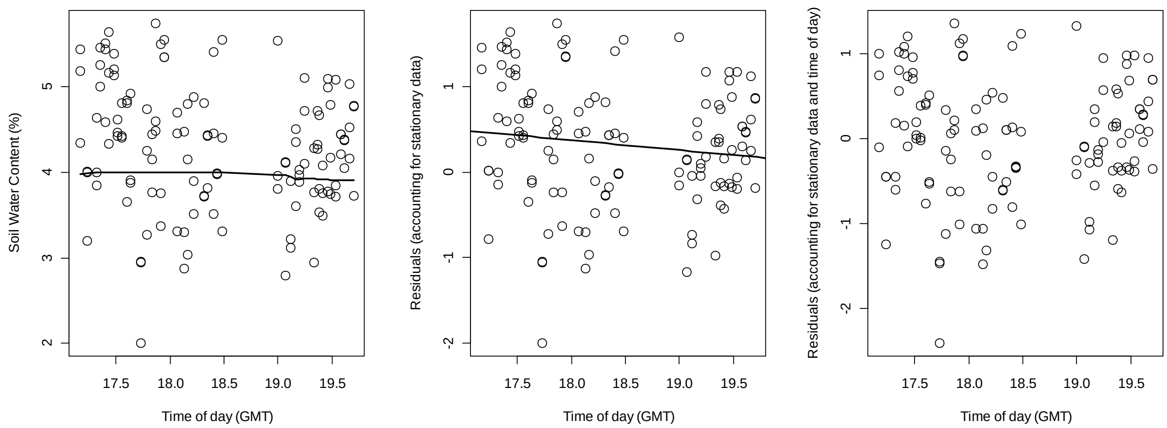


Figure 52. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting 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.

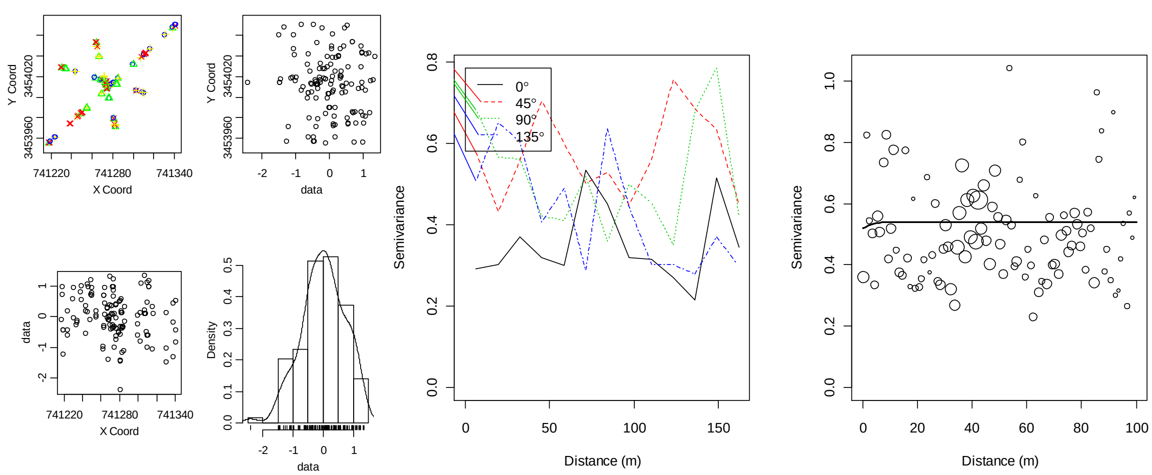


Figure 53. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

5.2.3.3 Soil array layout and soil pit location

The minimum distance allowable between soil plots is 25 m to ensure a degree of spatial independence in non-measured soil parameters (i.e., other than temperature and water content) and the maximum distance allowable between soil plots is 40 m due to cost constraints. The estimated distance of effective independence was 35 m for soil temperature and 8 m for soil moisture. Based on these results and the site design guidelines the soil plots at Jones shall be placed 35 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 40° from the soil plot nearest the tower (i.e., first soil plot). The location of the first soil plot will be approximately 31.19501°, -84.46858°. 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). In particular, soil plots should not contain or be close to hardwood trees as these will be felled 2-3 years after site construction and it is difficult to control the direction of the tree fall. 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 31.193613°,-84.461210° (primary); 31.195915°, -84.468792° (Alternative 1); or 31.196019°, -84.466520° (Alternative 2). A summary of the soil information is shown in Table 18 and site layout can be seen in Figure 54.

Dominant soil series at the site: Troup sand, 5 to 8 percent slopes. The taxonomy of this soil is shown below:
Order: Ultisols
Suborder: Udults
Great group: Kandiudults
Subgroup: Grossarenic Kandiudults
Family: Loamy, kaolinitic, thermic Grossarenic Kandiudults
Series: Troup sand, 5 to 8 percent slopes

Table 18. Summary of soil array and soil pit information at Jones.
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	35 m
Distance from tower to closest soil plot: y	19 m
Latitude and longitude of 1st soil plot OR direction from tower	31.19501°, -84.46858°
Direction of soil array	40°
Latitude and longitude of FIU soil pit 1	31.193613°,-84.461210° (primary)
Latitude and longitude of FIU soil pit 2	31.195915°, -84.468792° (Alternative 1)
Latitude and longitude of FIU soil pit 3	31.196019°, -84.466520° (Alternative 2)
Dominant soil type	Troup sand, 5 to 8 percent slopes
Expected soil depth	>2 m
Depth to water table	>2 m

Expected depth of soil horizons	**Expected measurement depths***
0-1.35 m (sand)	0.68 m
1.35-2 m (sandy clay loam)	1.68 m
	2.00 m

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

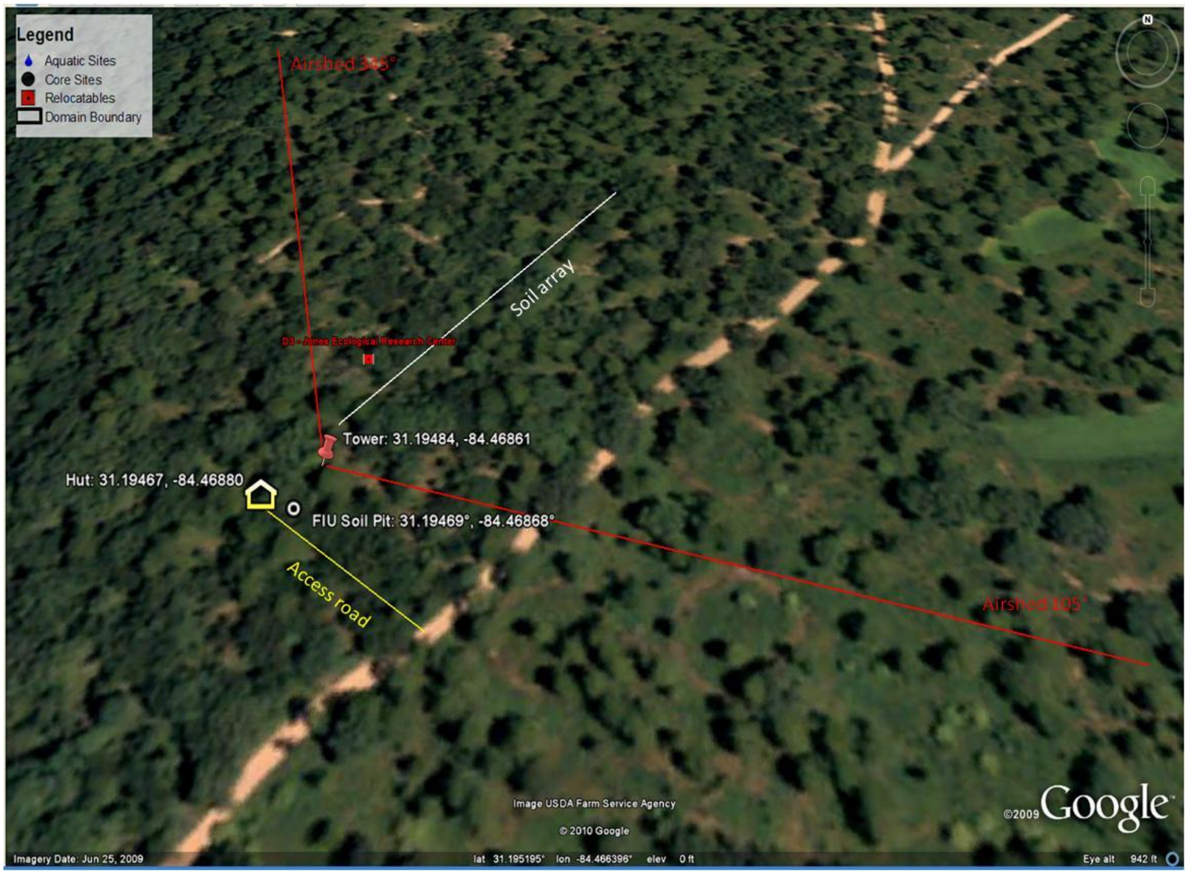


Figure 54. Site layout at Jones showing soil array and location of the FIU soil pit.
i) new tower location is presented, ii) red lines indicate the airshed boundaries. Vectors 345° and 105° (starting clockwise from 345°) bound the airshed, within which it would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut. iv) White line indicates soil array. Note that soil pit location in this map is not current. See table 18 for the current soil pit locations.

5.3 Airshed

5.3.1 Seasonal windroses

Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given timeseries, Figure 55-58. The weather data used to generate the following wind roses are from Bainbridge, FL, which is ~28 km away from The Jones Ecological Research Center Relocatable tower site. The orientation of the wind rose follows that of a compass (assume declination applied). When we describe the wind directions it should be noted that they are the cardinal direction that wind blows from. Color bands depict the range of wind speeds. 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.

5.3.2 Results (graphs for wind roses)

General (seasonal) circulation pattern Spring conditions shift toward mesoscale climate dominated by the sub-tropical Hadley cell and the Bermuda High. Weather comes predominately form the S-SE. Strom fronts push the weather patterns toward the E. The short winter circulations are controlled by the temperate Hadley cell, highs originating from the continental US. Storm fronts are often associated on an SW-NE frontal during the winter (From FIU site visit report in 2008).

Similar to Ordway core site, at this site, wind comes from all direction. We selected a direction that has relatively higher frequency as our dominant wind direction to run footprint model. In winter season, we select 315^o as model input, but wind comes from all directions (range from 285^o to 345^o and from 75^o to 255^o, **clockwise from first angle to second angle, same logic for the range below**). In spring, wind mainly from east (ranges from 75^o to 105^o) and other high frequency wind comes from southwest (ranges from 195^o to 255^o), and northeast (range from 345^o to 45^o). In summer, wind mainly comes from northeast direction (ranges from 45^o to 105^o). We select 75^o as model inputs. In autumn, wind mainly comes from north east direction and ranges from 345^o to 75^o). But we should keep in mind that wind actually comes from all directions in all seasons, which can be found in the wind roses. Therefore, consider all seasons through the year, wind blows more frequently from 345^o to 105^o (clockwise from 345^o). Other secondary airshed areas include from 105^o to 225^o (clockwise from 105^o) and from 285^o to 345^o. Among all areas, airshed from 345^o to 105^o has the highest frequency in all seasons, and therefore suggest to place FSU plots within this airshed area.

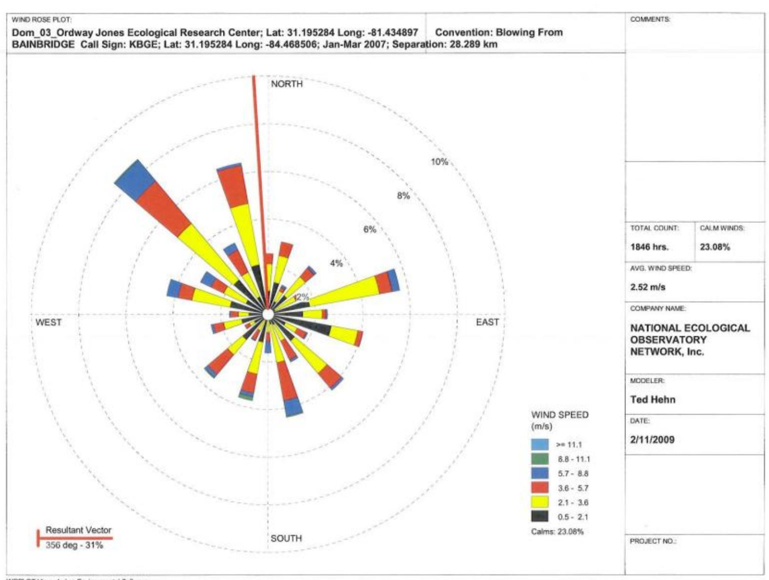


Figure 55. Windroses of January – March for D03 Jones Ecological Research Center Relocatable site.

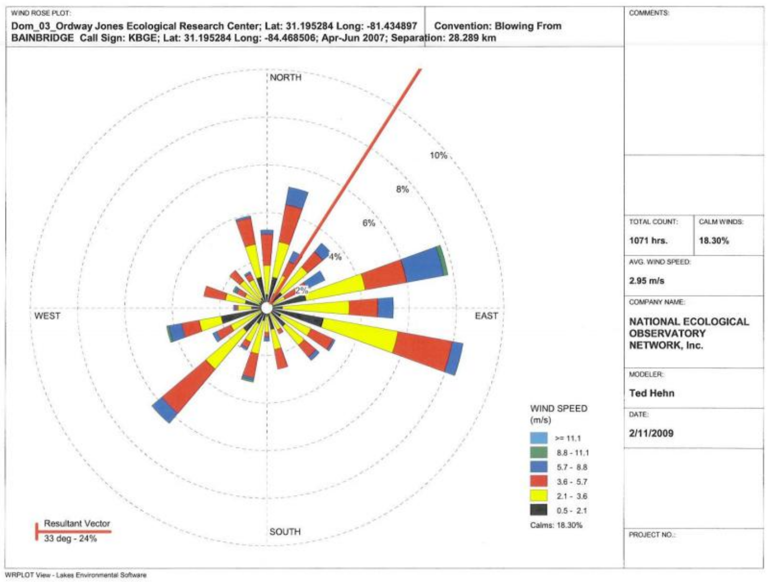


Figure 56. Windroses of April – June for D03 Jones Ecological Research Center Relocatable site.

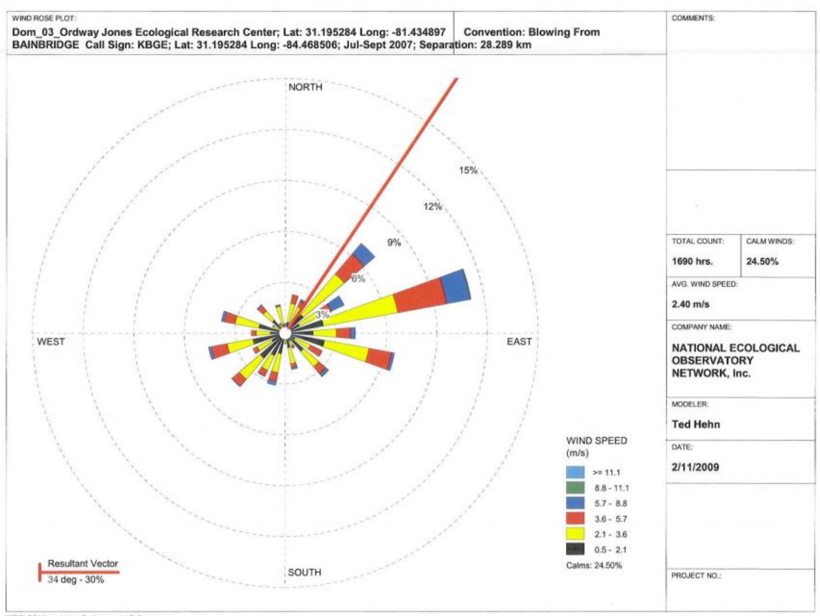


Figure 57. Windroses of July – September for D03 Jones Ecological Research Center Relocatable site.

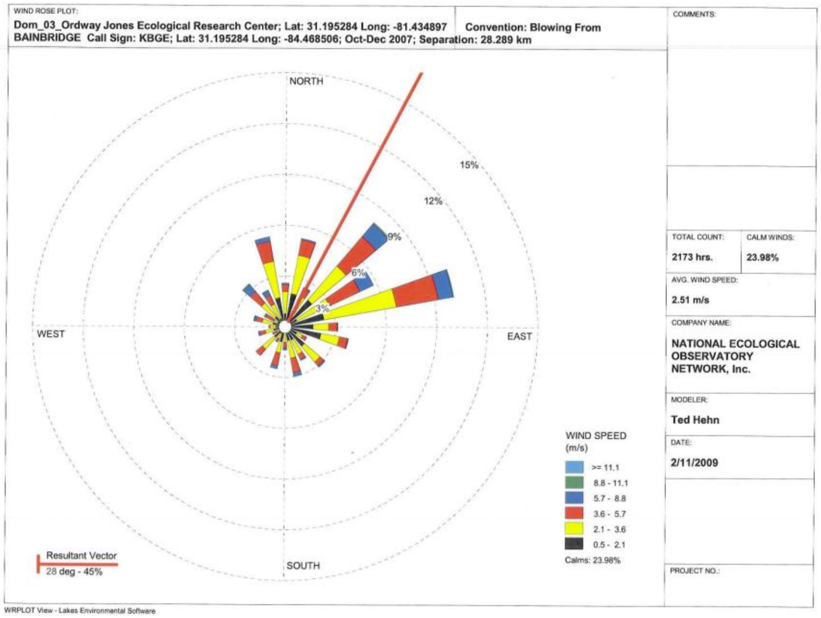


Figure 58. Windroses of October - December for D03 Jones Ecological Research Center Relocatable site.

5.3.3 Resultant vectors

Table 19. The resultant wind vectors for D03 Jones Ecological Research Center Relocatable site.

Quarterly (seasonal) timeperiod	Resultant vector	% duration
January to March	356°	31
April to June	33°	24
July to September	34°	30
October to December	28°	45
Annual mean	22.8°	na.

5.3.4 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, with support from Dr R. Clement, we use a web-based footprint model that programmed by Micrometeorology Group at University of Edinburgh, UK 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 estimates from experienced expert. Measurement height was obtained 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 wind speeds (daytime convective) and nighttime (stable atmospheres) conditions. The wind vector for each run was extracted from wind roses and is placed as a centerline in the site map included in the graphics. The longest distance between the isopleth of 80% cumulative flux and tower, along with the major wind direction, will define the source area for the flux measurements on the top of the tower.

Table 20 . Expected environmental controls to parameterize the source area model for Jones Ecological Center Relocatable 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	43	43	43	43	43	43	m
Canopy Height	27	27	27	27	27	27	m
Canopy area density	3	3	3	2	2	2	m
Boundary layer depth	2500	2500	700	900	900	500	m
Expected sensible heat flux	375	375	60	125	125	25	$W\ m^{-2}$
Air Temperature	28	28	20	13	13	9	°C
Max. windspeed	11	4.1	2.1	11	3.5	2.2	$m\ s^{-1}$
Resultant wind vector	75	75	75	315	315	315	degrees
Results							
(z-d)/L	-0.02	-0.23	-0.25	-0.01	-0.14	-0.14	m
d	22.00	22.00	22.00	20.00	20.00	20.00	m
Sigma v	3.60	2.30	0.99	3.30	1.50	0.85	$m^2\ s^{-2}$
Z0	1.20	1.20	1.20	1.50	1.50	1.50	m
u*	1.60	0.72	0.39	1.60	0.62	0.38	$m\ s^{-1}$
Distance source area begins	50	50	40	50	30	30	m
Distance of 90% cumulative flux	1180	580	560	1270	750	720	m
Distance of 80% cumulative flux	650	350	350	700	400	420	m
Distance of 70% cumulative flux	480	260	260	500	310	300	m
Peak contribution	105	75	65	105	85	85	m

5.3.5 Footprint model results (source area graphs)

From the footprint analysis below we can see majority signals that collect at the tower location (31.19484, -84.46861) will be from the longleaf pine ecosystem, which is the ecosystem we are interested in (see footprint outputs run 1-3 below and wind roses above). However, when wind blow from Northwest direction (~20 % of time in Jan to March), only 70% cumulative flux will be explained by the longleaf pine forest under mean wind conditions and other 30% signals will come from the different ecosystem on the other side of the creek (see footprint outputs run 4-6 below and wind roses above). However, from the wind roses, throughout the whole year, we still have >90% signals from the ecosystem we are interested in.

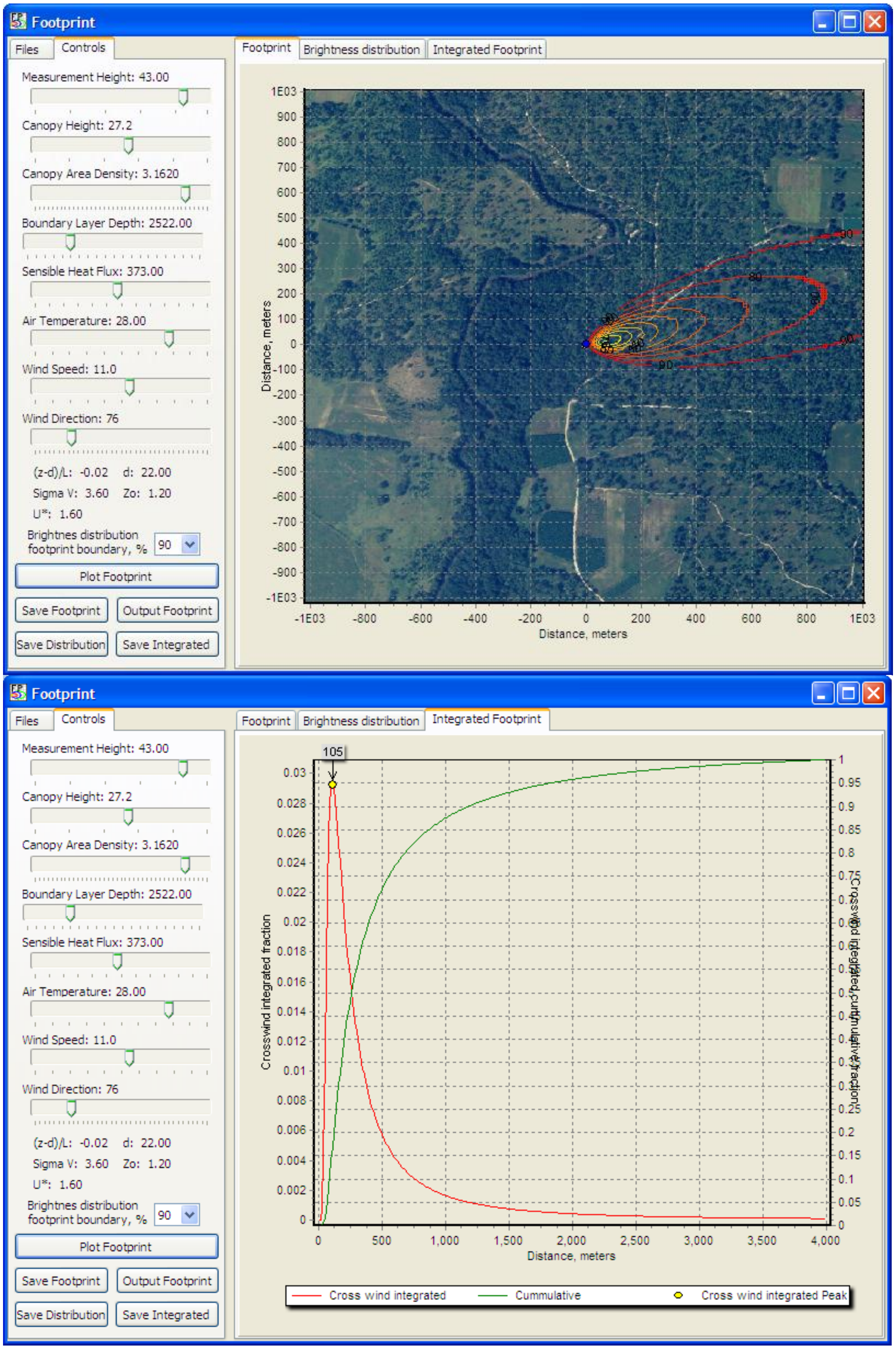
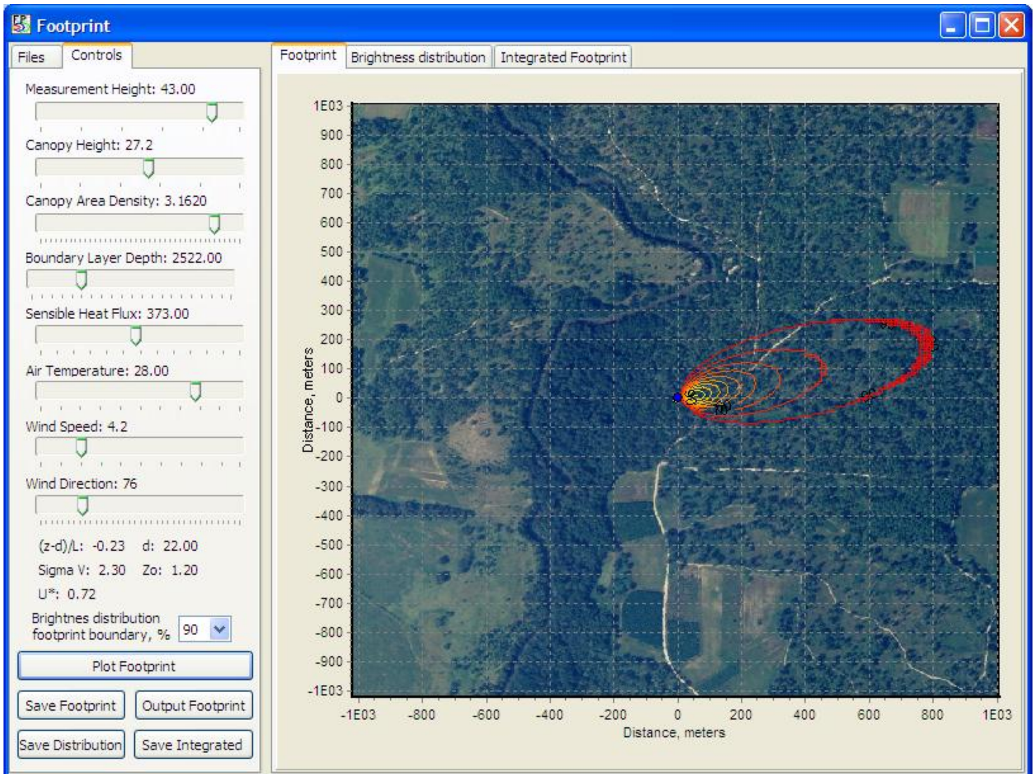


Figure 59. Footprint model output Run 1: summer, daytime, max WS



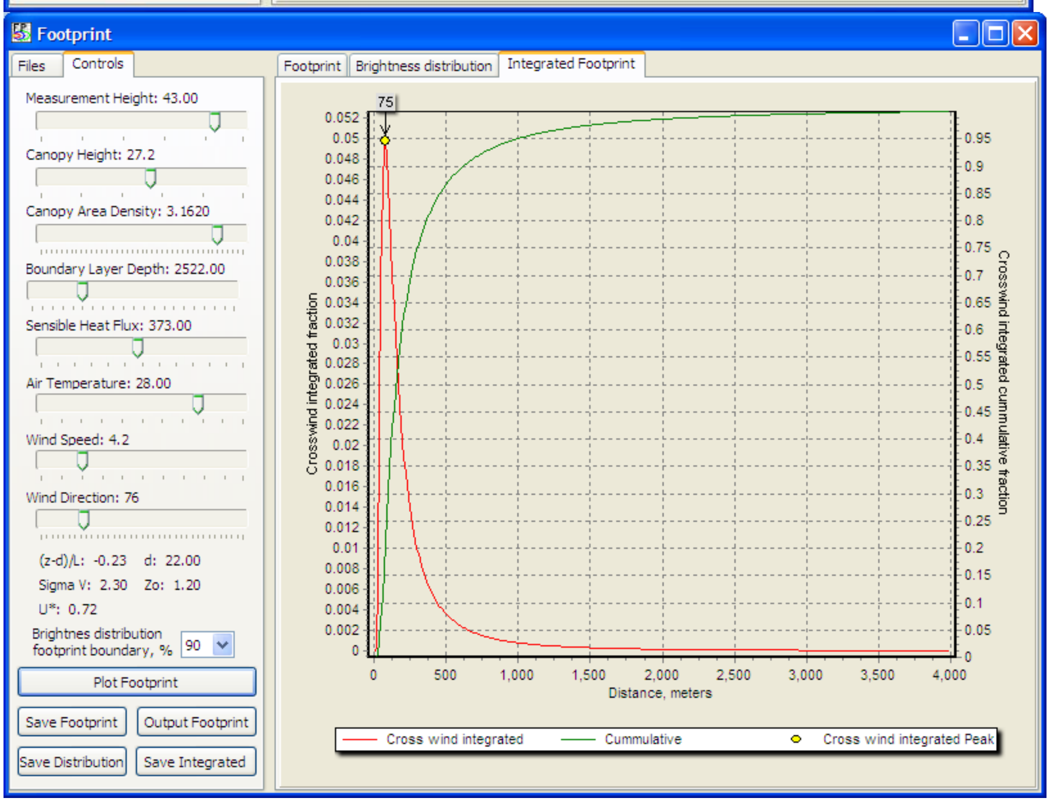


Figure 60. Footprint model output Run 2: summer, daytime, mean WS

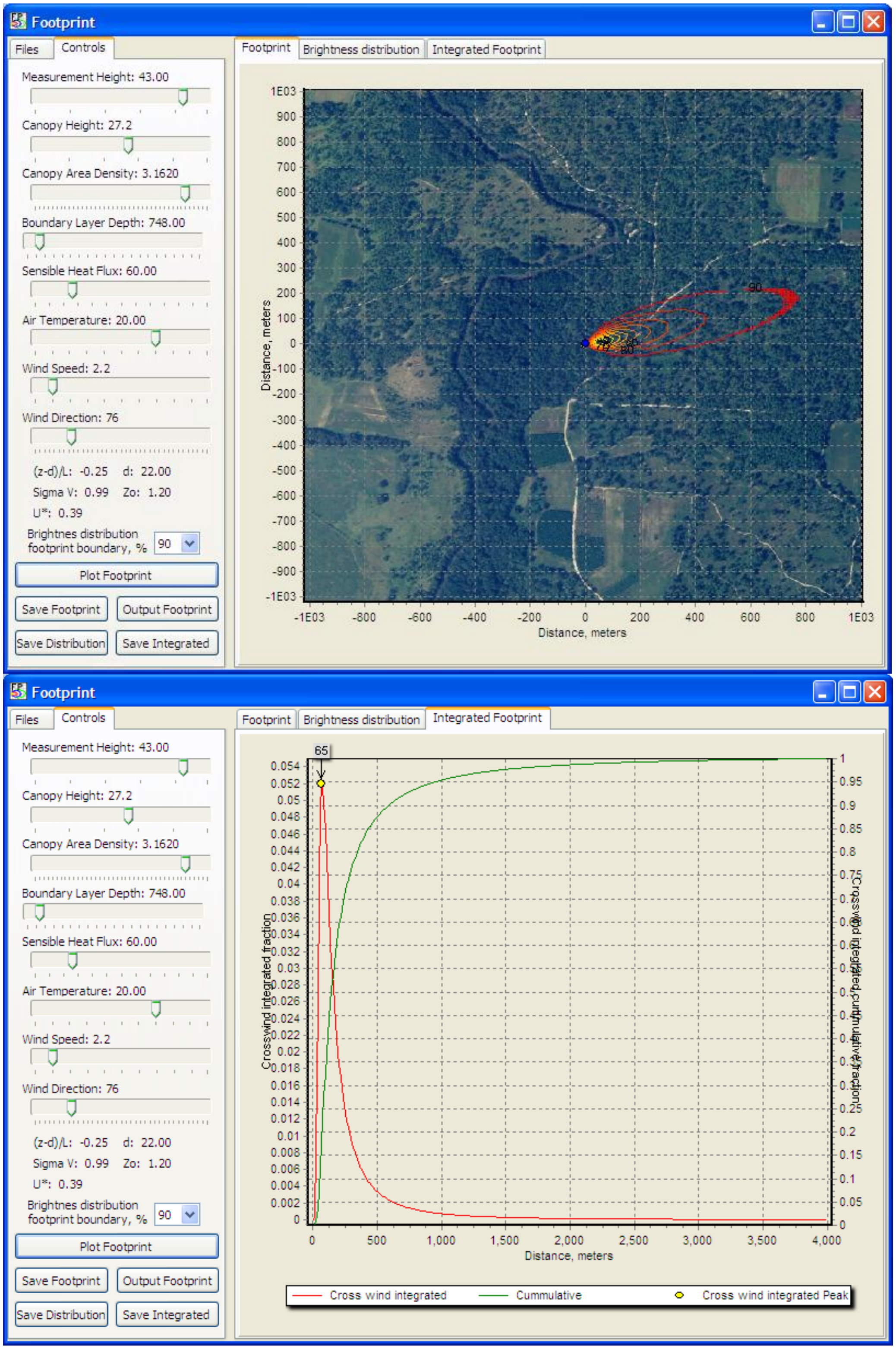


Figure 61. Footprint model output Run 3: summer, nighttime mean WS

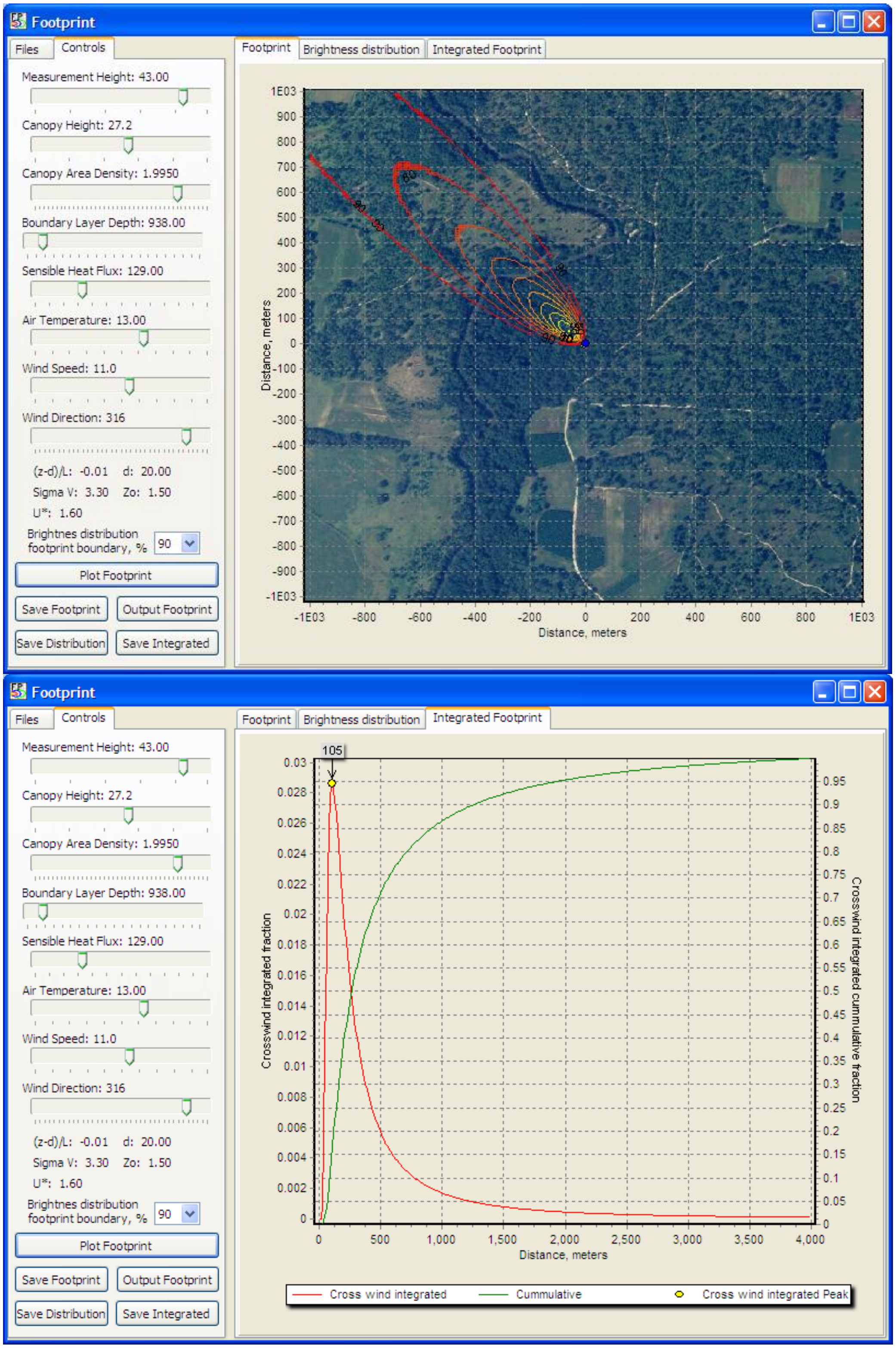


Figure 62. Footprint model output Run 4: winter, daytime, max WS

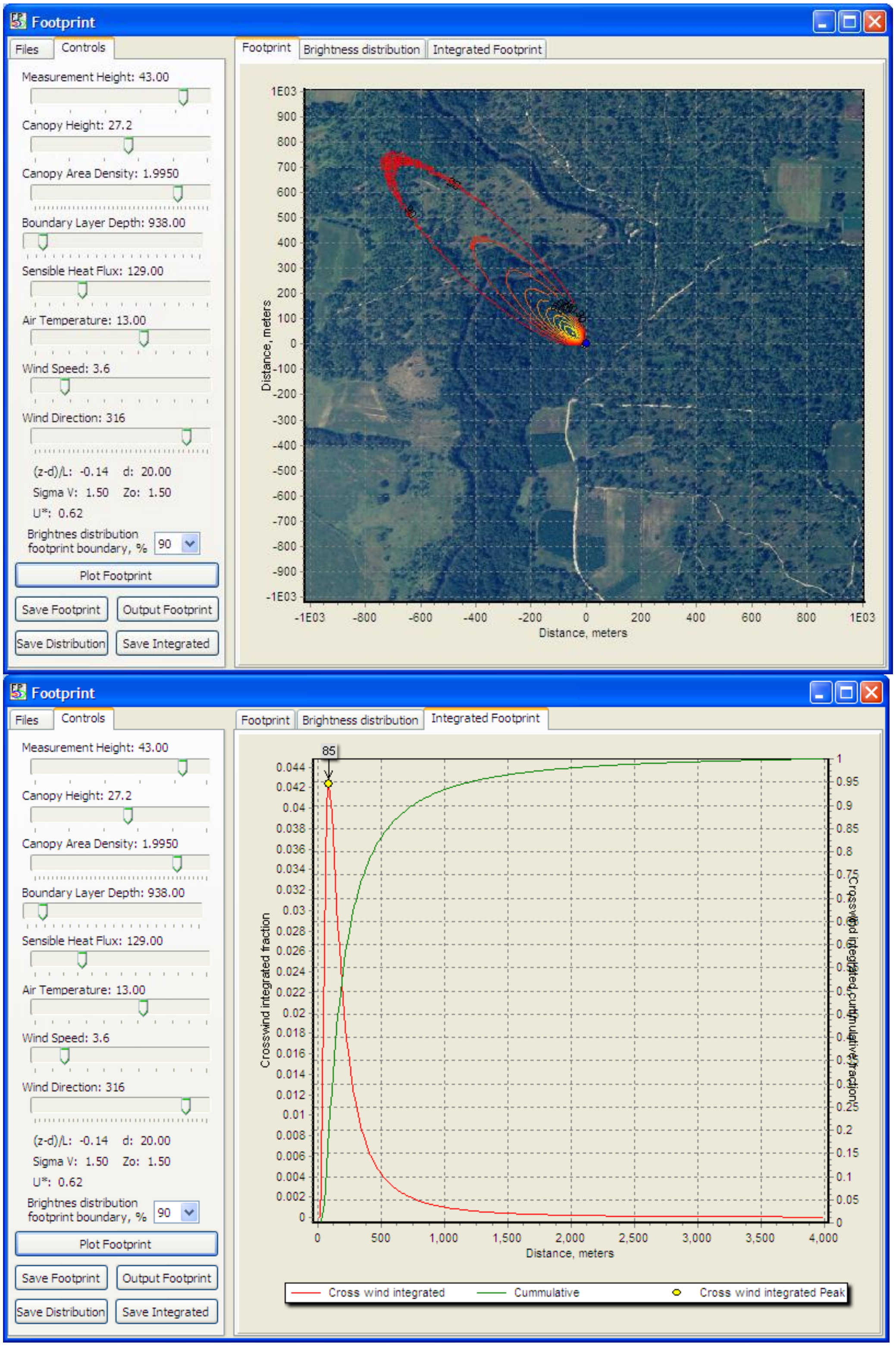


Figure 63. Footprint model output Run 5: winter, daytime, mean WS

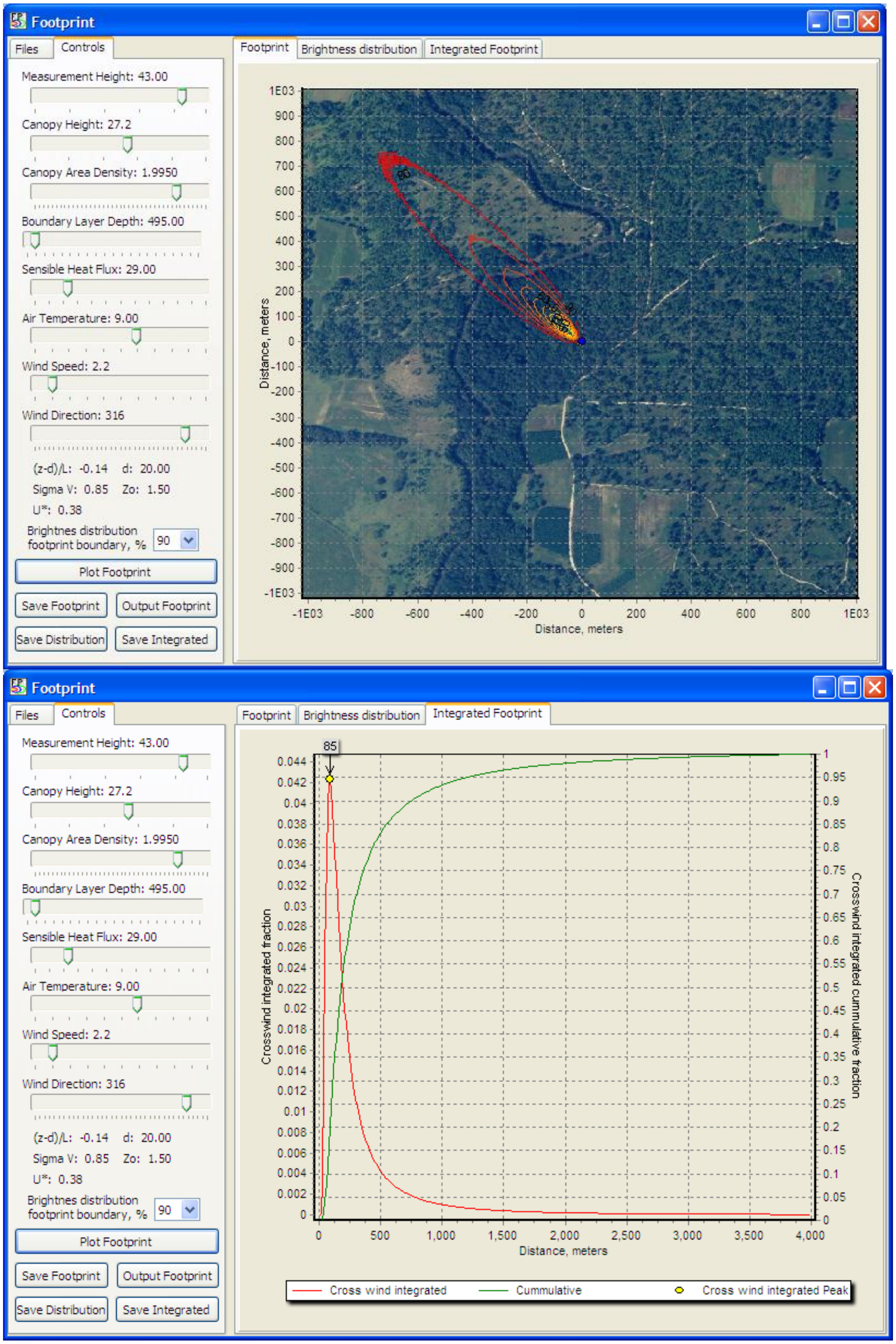


Figure 64. Footprint model output Run 6: winter, nighttime, mean WS

5.3.6 Tower location, instrument hut location, boardwalks, measurement layers on the tower and other sensor locations

Similar to Ordway core site, at this site, wind comes from all direction. However, consider all seasons through the year, wind blows more frequently from 345° to 105° (clockwise from 345°). Other secondary airshed areas include from 105° to 225° (clockwise from 105°) and from 285° to 345°. Among all areas, airshed from 345° to 105° has the highest frequency in all seasons.

The tower should be positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (Broom sedge prairie in this case). The footprint spans <700 m from tower for 80% cumulative flux measurement. The original tower site was lat 31.195284°, -84.468506°, after FIU site characterization, we determine the exact tower location to be at 31.19484°, -84.46861° to avoid the needs to cut any pine trees to establish tower. New location is about 50 m southwest of original tower location. Eddy covariance, sonic wind and temperature boom arms orientation toward East will maximize the quality wind and air signals from all major wind directions. Radiation boom arms should always be facing the North to avoid any shadowing effects from the tower structure. Instrument hut is 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

This site is longleaf pine forest. Canopy height is ~ 27 m around tower site and in the airshed area with lowest branch ~14 m. Young pine trees vary from ~3 m to ~20 m. Understory height varies from 0.4 m for wiregrass to 1 m for short perennials. We suggest 6 measurement layers on the tower with top measurement height at 42 m, and rest layers are 29 m, 23 m, 16 m, 7 m and 0.2 m, respectively.

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 conduit 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.

- There is always a boardwalk from the instrument hut to the tower
- There is never a boardwalk on the south side of the tower
- There is never a boardwalk within 4 m of the tower, except where it perpendicularly intersects the tower for access
- The boardwalk the access to the tower is not on any side that has a boom.
- There is never boardwalk within 10 m of a soil plot, except where it perpendicularly intersects a soil plot for access.

Specific Boardwalks at Jones Ecological Center

- Boardwalk from access road to instrument hut (from the south east)

- Boardwalk from the instrument hut to the tower to intersect on north face of the tower,
- Boardwalk to the soil array
- Boardwalks must be protected against controlled burns
- No boardwalk from the soil array boardwalk to the individual soil plots

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 21. Tower oriented design attributes for the Jones Center research RC 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			345° to 105°		Clockwise from 345°
Tower location	31.19484°,	-84.46861	--	--	new site
Tower orientation vector	--	--	45° to 225°	--	Shorter tower face parallel to 135° to 315°
Instrument hut	31.19467	-84.46880			
Instrument hut (perpendicular) orientation vector	--	--	45° to 225°		Shorter side parallel to 135° to 315°
Instrument hut distance z	--	--	--	25	
Anemometer/Temperature boom orientation	--	--	45°	--	From tower point to this direction
Height of the measurement levels					
Level 1				0.2	m.a.g.l.
Level 2				7.0	m.a.g.l.
Level 3				16.0	m.a.g.l.
Level 4				23.0	m.a.g.l.
Level 5				29.0	m.a.g.l.
Level 6				42.0	m.a.g.l.
Tower Height				42.0	m.a.g.l.

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

Figure 65 below shows the proposed tower location, instrument hut location, airshed area and access road.

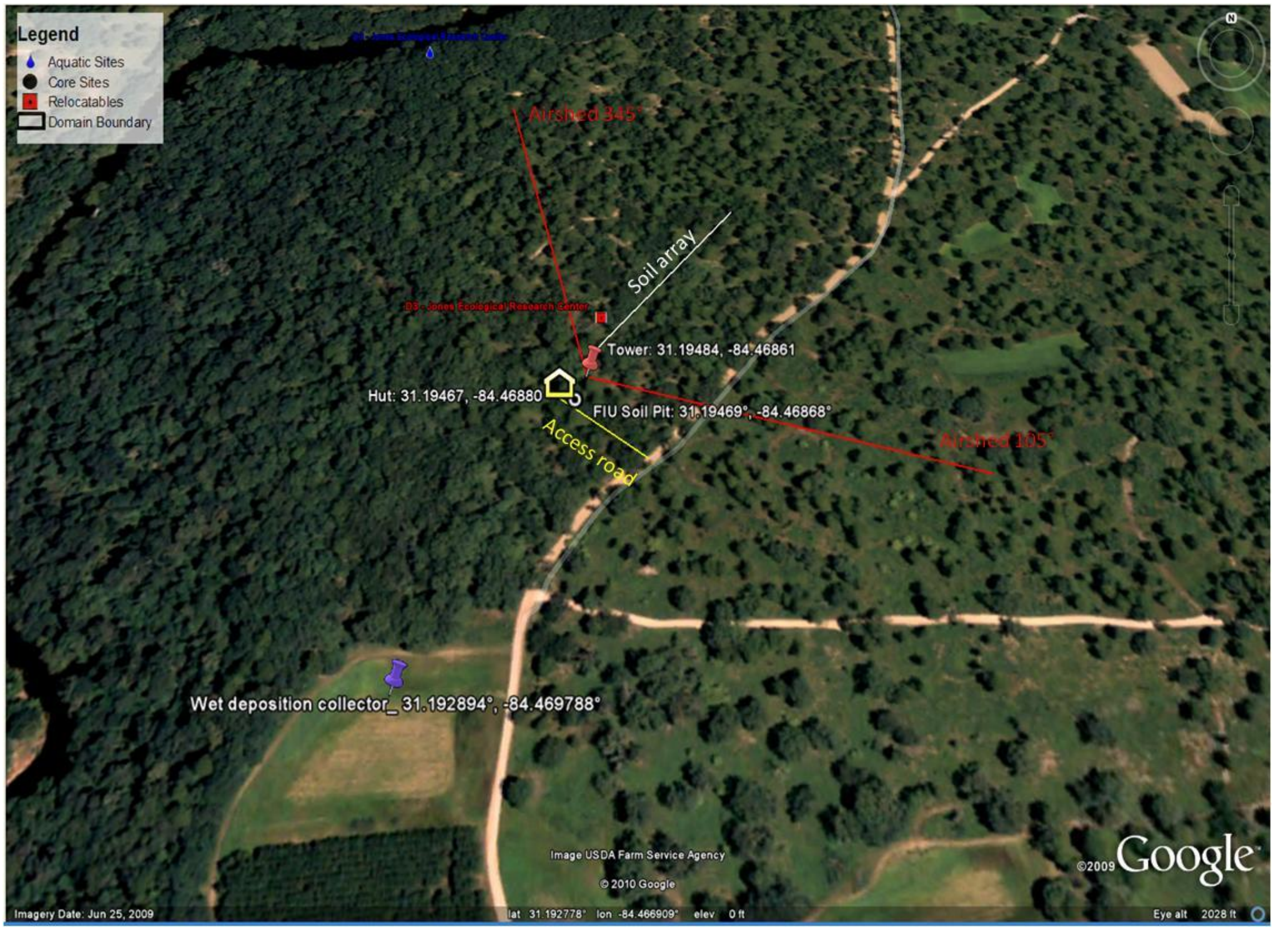


Figure 65. Plan view of D03 Jones Ecological Research Center Relocatable site location.

i) new tower location is presented, ii) red lines indicate the airshed boundaries. Vectors 345° and 105° (starting clockwise from 345°) bound the airshed, within which it would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut. iv) White line indicates soil array. v) purple pin indicates the proposed wet deposition collector. Note: soil pit location is not current. Please see Table 18 for current soil pit locations.

Keep in mind that all **radiation sensors** above canopy need to be mounted on the south side of the tower to avoid shadow from tower structure and mounting parts.

Secondary **precipitation collector** for bulk precipitation collection will be located the top of tower at this site. **Wet deposition collector** is proposed at the tower top, if for any reason this becomes not possible, the alternative site is at 31.192894, -84.469788. But this point hasn't been confirmed with local contact. If this wet deposition site doesn't work out, yet another alternative site will be at 31.215102°, -84.456930° next to Dr T. Meyers' Small DFIR, which is about 2100 m away for tower, but has power next to it. But this also need further discuss with site contact. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

5.3.7 Information for ecosystem productivity plots

The tower at Jones Ecological Research Center Relocatable site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (Broom sedge prairie). Wind vectors from the tower dictate the major airshed is from 345^o to 105^o (clockwise from 345^o, this is major airshed area). But wind comes from all directions at this site. 80% signals for flux measurements are within a distance of 700 m from tower. We recommend that the FSU Ecosystem Productivity plots should be placed within the airshed boundaries of the 345 degrees line and the 105 degree line(clockwise from 345^o, major airshed area).

6 REFERENCES

Abrahamson W.G. & Hartnett D.C. (1990). Pine flatwoods and dry prairie. In: *Ecosystems of Florida* (eds. Myers RL & Ewel JJ). University of Central Florida Press Orlando, pp. 103-149.

Bond-Lamberty B., Brown K.M., Goranson C. & Gower S.T. (2006). Spatial dynamics of soil moisture and temperature in a black spruce boreal chronosequence. *Canadian Journal of Forest Research-Revue Canadienne De Recherche Forestiere*, 36, 2794-2802.

Goovaerts P. (1997). *Geostatistics for Natural Resource Evaluation*. Oxford University Press, Oxford.

Mitchell R.J., Kirkman L.K., Pecot S.D., Wilson C.A., Boring L.R. & Palik B.J. (1998). Regulation of ecosystem function across complex environmental gradients in longleaf pine-wiregrass savannas. In: *Longleaf Pine: A Forward Look* (ed. Kush JS). The Longleaf Alliance, Solon Dixie Forestry Center, AL Charleston, SC, p. 127.

Myers, R.L., J. J. Ewel. 1990. Ecosystems of Florida. University Presses, Gainesville, FL, pp. 765.

Riberiro J.R. & Diggle P.J. (2001). geoR: A package for geostastical analysis. *R-NEWS*, 1, ISSN 1609-3631.

Trangmar B.B., Yost R.S. & Uehara G. (1986). Application of geostatistics to spatial studies of soil properties. *Advances in Agronomy*, 45-94.

Webster R. & Oliver M.A. (1989). Optimal interpolation and isarthmic mapping of soil properties: VI Disjuctive kriging and mapping the conditional probability. *Journal of Soil Science*, 40, 497-512.

7 APPENDIX A. R-CODE FOR SEMI-VARIOGRAM ANALYSES

7.1 Semivariogram code – Ordway

7.1.1 Temperature

```
# Set path for the location of the data
path.tmp<-
c("P:\\FIU\\FIU_Site_Characterization\\D03\\Ordway_Characterization\\Soil
Measurements\\Soil Data Analysis\\")
# Read in the data
tmp.data<-read.table(paste(path.tmp,"OrdwaySynthesized.txt",sep=""),header=T)

# extracting the times
time.tmp <- as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$hour +
            as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$min/60

# examining the structure of the data
head(tmp.data)

# Setting up graphics window
win.graph(height=10,width=8)

#plotting time trend
plot(time.tmp,tmp.data$temp,ylab="Temperature (°C)",xlab="Time of day
(GMT)",pch=21,bg=0,cex=1.5)
# adding the stationary swc measurement
lines(time.tmp,tmp.data$Stationary.temp,lwd=2)

# computing the residuals from the data minus the control
resid.dat<-tmp.data$temp-tmp.data$Stationary.temp

#plotting residuals through time
win.graph(height=10,width=8)
plot(time.tmp,resid.dat,ylab="Residuals (accounting for stationary
data)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

# fitting a linear regression model to residuals over time
lm.1<-lm(resid.dat~time.tmp)
summary(lm.1)
time.seq<- seq((min(time.tmp)-.25),(max(time.tmp)+.25),.1)
lines(time.seq,lm.1$coefficients[1]+time.seq*lm.1$coefficients[2],lwd=2)

# removing TOD trend from residuals
win.graph(height=10,width=8)
plot(time.tmp,lm.1$residuals,ylab="Residuals (accounting for stationary data
and time of day)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

#load the geoR library
require(geoR)

# define the geoR data structure that we will use for the spatial analysis
tmp.geo<-as.geodata(data.frame(cbind(tmp.data[,c(12,13)],lm.1$residuals)))
```

```
# exploratory data analysis plot
win.graph(height=10,width=8)
plot(tmp.geo)

#directional variogram
win.graph(height=10,width=8)
plot(variog4(tmp.geo),xlab="Distance (m)",ylab="Semivariance")

# variogram with bin
variog.1<-variog(tmp.geo,max.dist=300,option="bin",breaks=seq(0,400,1))
win.graph(height=10,width=8)
plot(variog.1,pch=" ",xlab="Distance (m)",ylab="Semivariance")

# setting up weights for sizes of circles in plots as a function of number of
pairs
weights.size<-sqrt((variog.1$n/sum(variog.1$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.1$n)){
points(variog.1$uvec[j],variog.1$v[j],cex=weights.size[j],pch=21,bg=0)
}

# variogram with bin for restricted distances
variog.2<-variog(tmp.geo,max.dist=100,option="bin",breaks=seq(0,100,1))
win.graph(height=10,width=8)
plot(variog.2,pch=" ",xlab="Distance (m)",ylab="Semivariance",xlim=c(0,100))

# setting up weights for sizes of circles in plots as a funciton of number of
pairs
weights.size<-sqrt((variog.2$n/sum(variog.2$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.2$n)){
points(variog.2$uvec[j],variog.2$v[j],cex=weights.size[j],pch=21,bg=0)
}

# fitting a variogram model ini.cov.pars correspond to variance and range
here
fit.2<-variofit(variog.2,cov.model="spherical",ini.cov.pars=c(0.4, 10)
,nugget=0.3,fix.nugget=F,weights="cressie")

lines(fit.2,col=1,lwd=2)

# output parameter estimates for variogram fit
fit.2
```

7.1.2 Soil water content

```
# Set path for the location of the data
path.tmp<-
c("P:\\FIU\\FIU_Site_Characterization\\D03\\Ordway_Characterization\\Soil
Measurements\\Soil Data Analysis\\")
# Read in the data
tmp.data<-read.table(paste(path.tmp,"OrdwaySynthesized.txt",sep=""),header=T)

# extracting the times
time.tmp <- as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$hour +
            as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$min/60

# examining the structure of the data
head(tmp.data)

# Setting up graphics window
win.graph(height=10,width=8)

#plotting time trend
plot(time.tmp,tmp.data$swc,ylab="Soil Water Content (%)",xlab="Time of day
(GMT)",pch=21,bg=0,cex=1.5)
# adding the stationary swc measurement
lines(time.tmp,tmp.data$Stationary.swc,lwd=2)

# computing the residuals from the data minus the control
resid.dat<-tmp.data$swc-tmp.data$Stationary.swc

#plotting residuals through time
win.graph(height=10,width=8)
plot(time.tmp,resid.dat,ylab="Residuals (accounting for stationary
data)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

# fitting a linear regression model to residuals over time
lm.1<-lm(resid.dat~time.tmp)
summary(lm.1)
time.seq<- seq((min(time.tmp)-.25),(max(time.tmp)+.25),.1)
lines(time.seq,lm.1$coefficients[1]+time.seq*lm.1$coefficients[2],lwd=2)

# removing TOD trend from residuals
win.graph(height=10,width=8)
plot(time.tmp,lm.1$residuals,ylab="Residuals (accounting for stationary data
and time of day)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

#load the geoR library
require(geoR)

# define the geoR data structure that we will use for the spatial analysis
tmp.geo<-as.geodata(data.frame(cbind(tmp.data[,c(12,13)],lm.1$residuals)))

# exploratory data analysis plot
win.graph(height=10,width=8)
plot(tmp.geo)
```

```
#directional variogram
win.graph(height=10,width=8)
plot(variog4(tmp.geo),xlab="Distance (m)",ylab="Semivariance")

# variogram with bin
variog.1<-variog(tmp.geo,max.dist=300,option="bin",breaks=seq(0,300,1))
win.graph(height=10,width=8)
plot(variog.1,pch=" ",xlab="Distance (m)",ylab="Semivariance")

# setting up weights for sizes of circles in plots as a function of number of
pairs
weights.size<-sqrt((variog.1$n/sum(variog.1$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.1$n)){
points(variog.1$uvec[j],variog.1$v[j],cex=weights.size[j],pch=21,bg=0)
}

# variogram with bin for restricted distances
variog.2<-variog(tmp.geo,max.dist=100,option="bin",breaks=seq(0,100,1))
win.graph(height=10,width=8)
plot(variog.2,pch=" ",xlab="Distance (m)",ylab="Semivariance",xlim=c(0,100))

# setting up weights for sizes of circles in plots as a funciton of number of
pairs
weights.size<-sqrt((variog.2$n/sum(variog.2$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.2$n)){
points(variog.2$uvec[j],variog.2$v[j],cex=weights.size[j],pch=21,bg=0)
}

# fitting a variogram model ini.cov.pars correspond to variance and range
here
fit.2<-variofit(variog.2,cov.model="spherical",ini.cov.pars=c(0.4, 10)
,nugget=0.3,fix.nugget=F,weights="cressie")

lines(fit.2,col=1,lwd=2)

# output parameter estimates for variogram fit
fit.2
```

7.2 Semivariogram code – Disney

7.2.1 Temperature

```
# Set path for the location of the data
path.tmp<-
c("P:\\FIU\\FIU_Site_Characterization\\D03\\Disney_Characterization\\Soil
Measurements\\Soil Data Analysis\\")
# Read in the data
tmp.data<-read.table(paste(path.tmp,"DisneySynthesized.txt",sep=""),header=T)
```

```
# extracting the times
time.tmp <- as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$hour +
            as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$min/60

# examining the structure of the data
head(tmp.data)

# Setting up graphics window
win.graph(height=10,width=8)

#plotting time trend
plot(time.tmp,tmp.data$temp,ylab="Temperature (°C)",xlab="Time of day
(GMT)",pch=21,bg=0,cex=1.5)
# adding the stationary swc measurement
lines(time.tmp,tmp.data$Stationary.temp,lwd=2)

# computing the residuals from the data minus the control
resid.dat<-tmp.data$temp-tmp.data$Stationary.temp

#plotting residuals through time
win.graph(height=10,width=8)
plot(time.tmp,resid.dat,ylab="Residuals (accounting for stationary
data)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

# fitting a linear regression model to residuals over time
lm.1<-lm(resid.dat~time.tmp)
summary(lm.1)
time.seq<- seq((min(time.tmp)-.25),(max(time.tmp)+.25),.1)
lines(time.seq,lm.1$coefficients[1]+time.seq*lm.1$coefficients[2],lwd=2)

# removing TOD trend from residuals
win.graph(height=10,width=8)
plot(time.tmp,lm.1$residuals,ylab="Residuals (accounting for stationary data
and time of day)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

#load the geoR library
require(geoR)

# define the geoR data structure that we will use for the spatial analysis
tmp.geo<-as.geodata(data.frame(cbind(tmp.data[,c(12,13)],lm.1$residuals)))

# exploratory data analysis plot
win.graph(height=10,width=8)
plot(tmp.geo)

#directional variogram
win.graph(height=10,width=8)
plot(variog4(tmp.geo),xlab="Distance (m)",ylab="Semivariance")

# variogram with bin
variog.1<-variog(tmp.geo,max.dist=300,option="bin",breaks=seq(0,300,1))
win.graph(height=10,width=8)
plot(variog.1,pch=" ",xlab="Distance (m)",ylab="Semivariance")
```

```
# setting up weights for sizes of circles in plots as a function of number of
pairs
weights.size<-sqrt((variog.1$n/sum(variog.1$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.1$n)){
points(variog.1$uvec[j],variog.1$v[j],cex=weights.size[j],pch=21,bg=0)
}

# variogram with bin for restricted distances
variog.2<-variog(tmp.geo,max.dist=100,option="bin",breaks=seq(0,100,1))
win.graph(height=10,width=8)
plot(variog.2,pch=" ",xlab="Distance (m)",ylab="Semivariance",xlim=c(0,100))

# setting up weights for sizes of circles in plots as a funciton of number of
pairs
weights.size<-sqrt((variog.2$n/sum(variog.2$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.2$n)){
points(variog.2$uvec[j],variog.2$v[j],cex=weights.size[j],pch=21,bg=0)
}

# fitting a variogram model ini.cov.pars correspond to variance and range
here
fit.2<-variofit(variog.2,cov.model="spherical",ini.cov.pars=c(0.4, 10)
,nugget=0.3,fix.nugget=F,weights="cressie")

lines(fit.2,col=1,lwd=2)

# output parameter estimates for variogram fit
fit.2
```

7.2.2 Soil water content

```
# Set path for the location of the data
path.tmp<-
c("P:\\FIU\\FIU_Site_Characterization\\D03\\Disney_Characterization\\Soil
Measurements\\Soil Data Analysis\\")
# Read in the data
tmp.data<-read.table(paste(path.tmp,"DisneySynthesized.txt",sep=""),header=T)

# extracting the times
time.tmp <- as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$hour +
            as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$min/60

# examining the structure of the data
head(tmp.data)

# Setting up graphics window
win.graph(height=10,width=8)
```

```
#plotting time trend
plot(time.tmp,tmp.data$swc,ylab="Soil Water Content (%)",xlab="Time of day
(GMT)",pch=21,bg=0,cex=1.5)
# adding the stationary swc measurement
lines(time.tmp,tmp.data$Stationary.swc,lwd=2)

# computing the residuals from the data minus the control
resid.dat<-tmp.data$swc-tmp.data$Stationary.swc

#plotting residuals through time
win.graph(height=10,width=8)
plot(time.tmp,resid.dat,ylab="Residuals (accounting for stationary
data)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

# fitting a linear regression model to residuals over time
lm.1<-lm(resid.dat~time.tmp)
summary(lm.1)
time.seq<- seq((min(time.tmp)-.25),(max(time.tmp)+.25),.1)
lines(time.seq,lm.1$coefficients[1]+time.seq*lm.1$coefficients[2],lwd=2)

# removing TOD trend from residuals
win.graph(height=10,width=8)
plot(time.tmp,lm.1$residuals,ylab="Residuals (accounting for stationary data
and time of day)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

#load the geoR library
require(geoR)

# define the geoR data structure that we will use for the spatial analysis
tmp.geo<-as.geodata(data.frame(cbind(tmp.data[,c(12,13)],lm.1$residuals)))

# exploratory data analysis plot
win.graph(height=10,width=8)
plot(tmp.geo)

#directional variogram
win.graph(height=10,width=8)
plot(variog4(tmp.geo),xlab="Distance (m)",ylab="Semivariance")

# variogram with bin
variog.1<-variog(tmp.geo,max.dist=300,option="bin",breaks=seq(0,300,1))
win.graph(height=10,width=8)
plot(variog.1,pch=" ",xlab="Distance (m)",ylab="Semivariance")

# setting up weights for sizes of circles in plots as a function of number of
pairs
weights.size<-sqrt((variog.1$n/sum(variog.1$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.1$n)){
points(variog.1$uvec[j],variog.1$v[j],cex=weights.size[j],pch=21,bg=0)
}

# variogram with bin for restricted distances
variog.2<-variog(tmp.geo,max.dist=85,option="bin",breaks=seq(0,100,1))
```

```
win.graph(height=10,width=8)
plot(variog.2,pch=" ",xlab="Distance (m)",ylab="Semivariance",xlim=c(0,100))

# setting up weights for sizes of circles in plots as a funciton of number of
pairs
weights.size<-sqrt((variog.2$n/sum(variog.2$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.2$n)){
points(variog.2$uvec[j],variog.2$v[j],cex=weights.size[j],pch=21,bg=0)
}

# fitting a variogram model ini.cov.pars correspond to variance and range
here
fit.2<-variofit(variog.2,cov.model="spherical",ini.cov.pars=c(0.4, 10)
,nugget=0.3,fix.nugget=F,weights="cressie")

lines(fit.2,col=1,lwd=2)

# output parameter estimates for variogram fit
fit.2
```

7.3 Semivariogram code – Jones

7.3.1 Temperature

```
# Set path for the location of the data
path.tmp<-
c("P:\\FIU\\FIU_Site_Characterization\\D03\\Jones_Characterization\\Soil
Measurements\\Soil Data Analysis\\")
# Read in the data
tmp.data<-read.table(paste(path.tmp,"JonesSynthesized.txt",sep=""),header=T)

# extracting the times
time.tmp <- as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$hour +
            as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$min/60

# examining the structure of the data
head(tmp.data)

# Setting up graphics window
win.graph(height=10,width=8)

#plotting time trend
plot(time.tmp,tmp.data$temp,ylab="Temperature (°C)",xlab="Time of day
(GMT)",pch=21,bg=0,cex=1.5)
# adding the stationary swc measurement
lines(time.tmp,tmp.data$Stationary.temp,lwd=2)

# computing the residuals from the data minus the control
resid.dat<-tmp.data$temp-tmp.data$Stationary.temp
```

```
#plotting residuals through time
win.graph(height=10,width=8)
plot(time.tmp,resid.dat,ylab="Residuals (accounting for stationary
data)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

# fitting a linear regression model to residuals over time
lm.1<-lm(resid.dat~time.tmp)
summary(lm.1)
time.seq<- seq((min(time.tmp)-.25),(max(time.tmp)+.25),.1)
lines(time.seq,lm.1$coefficients[1]+time.seq*lm.1$coefficients[2],lwd=2)

# removing TOD trend from residuals
win.graph(height=10,width=8)
plot(time.tmp,lm.1$residuals,ylab="Residuals (accounting for stationary data
and time of day)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

#load the geoR library
require(geoR)

# define the geoR data structure that we will use for the spatial analysis
tmp.geo<-as.geodata(data.frame(cbind(tmp.data[,c(12,13)],lm.1$residuals)))

# exploratory data analysis plot
win.graph(height=10,width=8)
plot(tmp.geo)

#directional variogram
win.graph(height=10,width=8)
plot(variog4(tmp.geo),xlab="Distance (m)",ylab="Semivariance")

# variogram with bin
variog.1<-variog(tmp.geo,max.dist=300,option="bin",breaks=seq(0,300,1))
win.graph(height=10,width=8)
plot(variog.1,pch=" ",xlab="Distance (m)",ylab="Semivariance")

# setting up weights for sizes of circles in plots as a function of number of
pairs
weights.size<-sqrt((variog.1$n/sum(variog.1$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.1$n)){
points(variog.1$uvec[j],variog.1$v[j],cex=weights.size[j],pch=21,bg=0)
}

# variogram with bin for restricted distances
variog.2<-variog(tmp.geo,max.dist=100,option="bin",breaks=seq(0,100,1))
win.graph(height=10,width=8)
plot(variog.2,pch=" ",xlab="Distance (m)",ylab="Semivariance",xlim=c(0,100))

# setting up weights for sizes of circles in plots as a funciton of number of
pairs
weights.size<-sqrt((variog.2$n/sum(variog.2$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.2$n)){
```

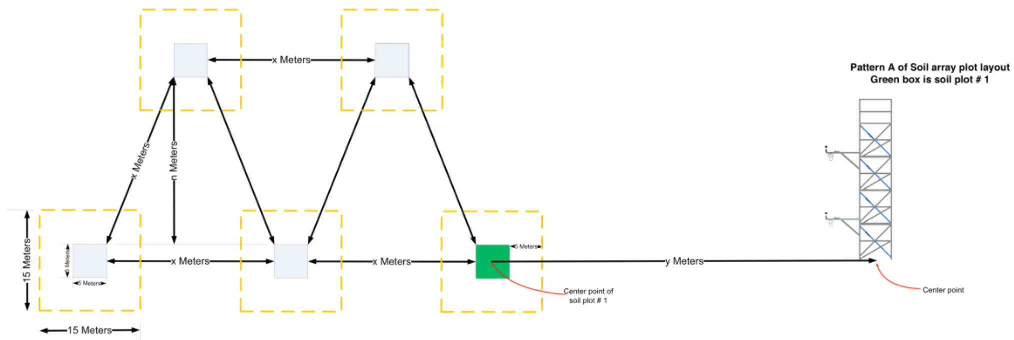
```
points(variog.2$uvec[j],variog.2$v[j],cex=weights.size[j],pch=21,bg=0)
}

# fitting a variogram model ini.cov.pars correspond to variance and range
here
fit.2<-variofit(variog.2,cov.model="spherical",ini.cov.pars=c(0.06, 35)
,nugget=0.01,fix.nugget=F,weights="cressie")

lines(fit.2,col=1,lwd=2)

# output parameter estimates for variogram fit
fit.2
```

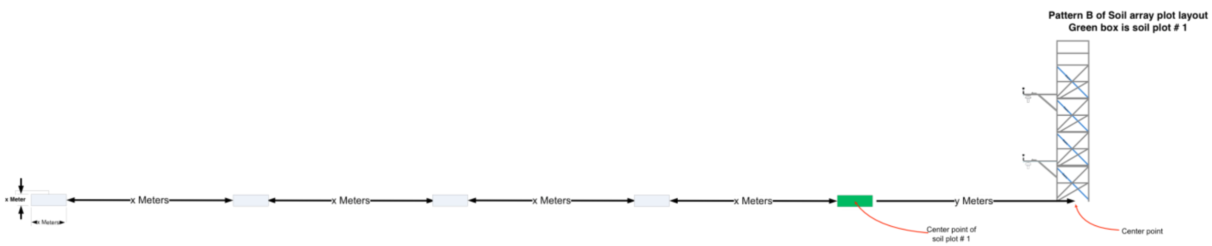
7.3.2 Soil water content

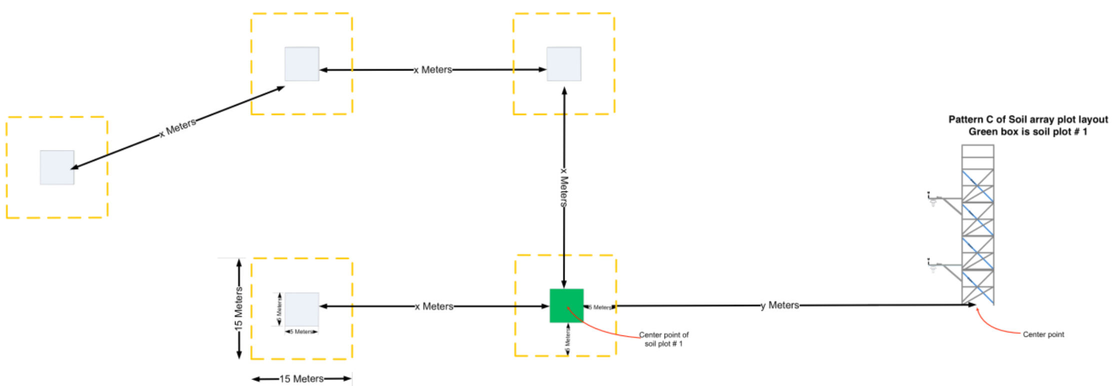
```
# Set path for the location of the data
path.tmp<-
c("P:\\FIU\\FIU_Site_Characterization\\D03\\Jones_Characterization\\Soil
Measurements\\Soil Data Analysis\\")
# Read in the data
tmp.data<-read.table(paste(path.tmp,"JonesSynthesized.txt",sep=""),header=T)

# extracting the times
time.tmp <- as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$hour +
            as.POSIXlt(strptime(as.character(tmp.data$time),"%H:%M"))$min/60

# examining the structure of the data
head(tmp.data)

# Setting up graphics window
win.graph(height=10,width=8)

#plotting time trend
plot(time.tmp,tmp.data$swc,ylab="Soil Water Content (%)",xlab="Time of day
(GMT)",pch=21,bg=0,cex=1.5)
# adding the stationary swc measurement
lines(time.tmp,tmp.data$Stationary.swc,lwd=2)

# computing the residuals from the data minus the control
resid.dat<-tmp.data$swc-tmp.data$Stationary.swc

#plotting residuals through time
win.graph(height=10,width=8)
plot(time.tmp,resid.dat,ylab="Residuals (accounting for stationary
data)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

# fitting a linear regression model to residuals over time
lm.1<-lm(resid.dat~time.tmp)
summary(lm.1)
time.seq<- seq((min(time.tmp)-.25),(max(time.tmp)+.25),.1)
lines(time.seq,lm.1$coefficients[1]+time.seq*lm.1$coefficients[2],lwd=2)

# removing TOD trend from residuals
```

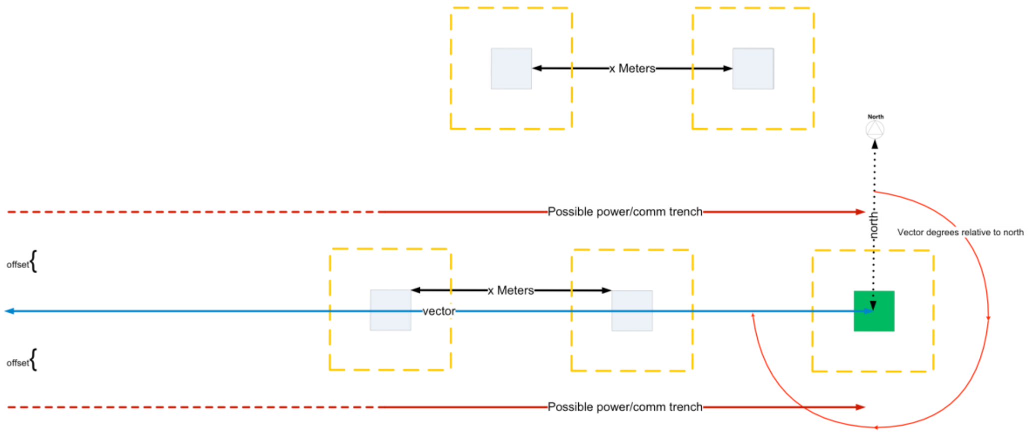
```
win.graph(height=10,width=8)
plot(time.tmp,lm.1$residuals,ylab="Residuals (accounting for stationary data
and time of day)",xlab="Time of day (GMT)",pch=21,bg=0,cex=1.5)

#load the geoR library
require(geoR)

# define the geoR data structure that we will use for the spatial analysis
tmp.geo<-as.geodata(data.frame(cbind(tmp.data[,c(12,13)],lm.1$residuals)))

# exploratory data analysis plot
win.graph(height=10,width=8)
plot(tmp.geo)

#directional variogram
win.graph(height=10,width=8)
plot(variog4(tmp.geo),xlab="Distance (m)",ylab="Semivariance")

# variogram with bin
variog.1<-variog(tmp.geo,max.dist=300,option="bin",breaks=seq(0,300,1))
win.graph(height=10,width=8)
plot(variog.1,pch=" ",xlab="Distance (m)",ylab="Semivariance")

# setting up weights for sizes of circles in plots as a function of number of
pairs
weights.size<-sqrt((variog.1$n/sum(variog.1$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.1$n)){
points(variog.1$uvec[j],variog.1$v[j],cex=weights.size[j],pch=21,bg=0)
}

# variogram with bin for restricted distances
variog.2<-variog(tmp.geo,max.dist=100,option="bin",breaks=seq(0,100,1))
win.graph(height=10,width=8)
plot(variog.2,pch=" ",xlab="Distance (m)",ylab="Semivariance",xlim=c(0,100))

# setting up weights for sizes of circles in plots as a funciton of number of
pairs
weights.size<-sqrt((variog.2$n/sum(variog.2$n)))*15

# plotting circle size as a function of number of pairs
for(j in 1:length(variog.2$n)){
points(variog.2$uvec[j],variog.2$v[j],cex=weights.size[j],pch=21,bg=0)
}

# fitting a variogram model ini.cov.pars correspond to variance and range
here
fit.2<-variofit(variog.2,cov.model="spherical",ini.cov.pars=c(0.4, 10)
,nugget=0.3,fix.nugget=F,weights="cressie")

lines(fit.2,col=1,lwd=2)

# output parameter estimates for variogram fit
fit.2
```

8 APPENDIX B. OPTIONAL SOIL ARRAY PATTERNS.

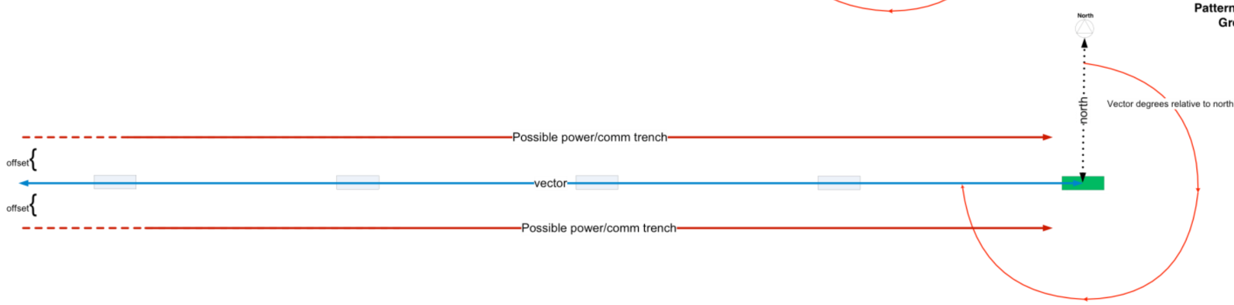




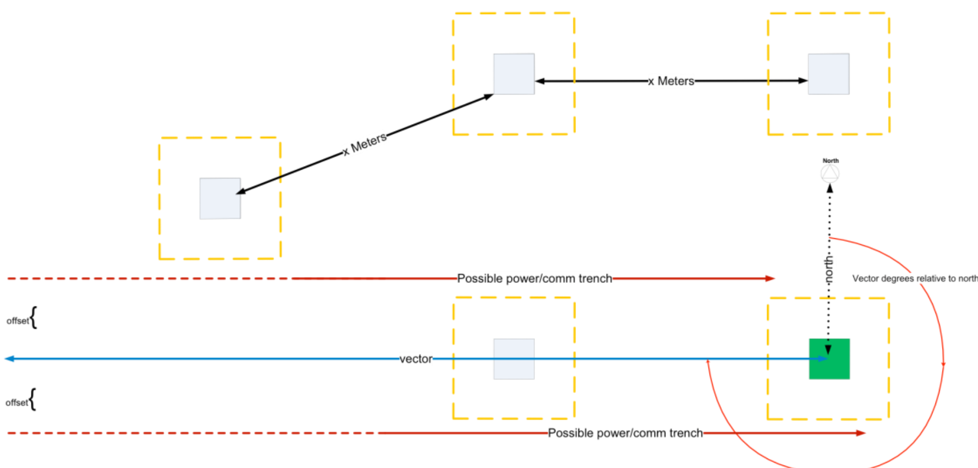




Pattern A of Soil array plot layout
Green box is soil plot # 1



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