Web3D Showcase – March 25, 2014
Virginia Tech - Arlington, Virginia

Next Generation Spatial Data Infrastructures

Peter Sforza

Virginia Tech

Director, Center for Geospatial Information Technology

http://www.cgit.vt.edu/

sforza@vt.edu

Ph: (540) 231-8940

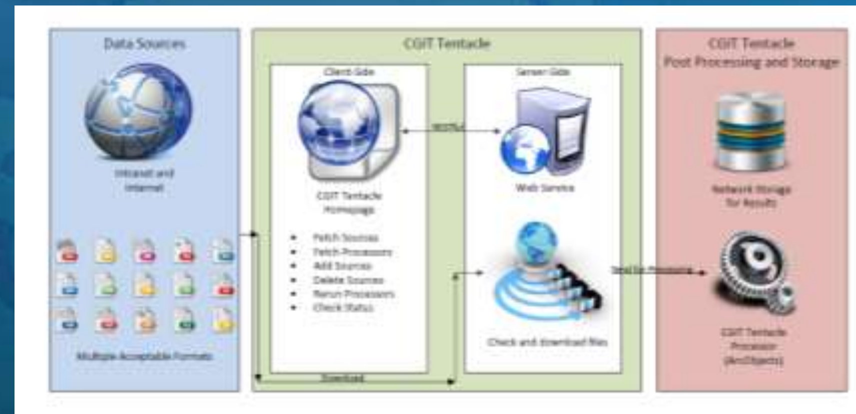
Next Generation Spatial Data Infrastructures

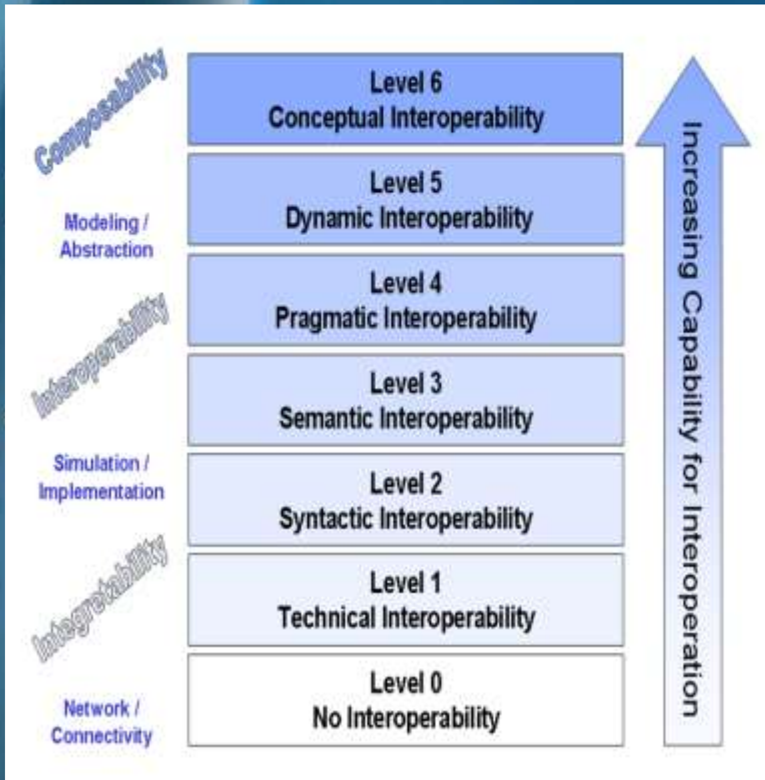
- 3D Blacksburg was created to harmonize the various users and producers of 3d city models.
- VT CGIT is engaged in several applied domains for local to global SDI research
  - Campus CAD-GIS-BIM
  - TOB WiFi design and optimization
  - Regional 911
  - VA DSM, Parcel, RRCL
  - VA / National Broadband Mapping
  - VA Dept of Motor Vehicle crash records
  - VA Dept of Emergency Management
  - Eastern US Site Assessment
  - Global Agroclimate
  - International Charter for Space and Major Disasters

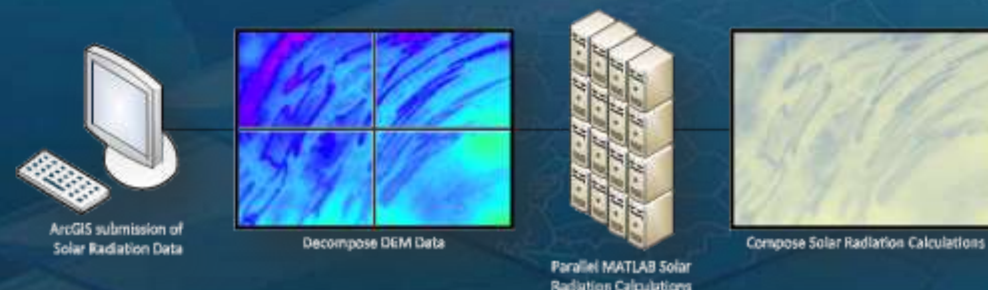
Research Infrastructure

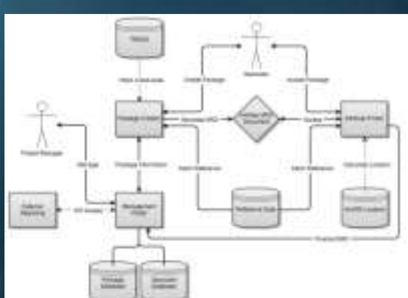
Peter Sforza, Director
sforza@vt.edu

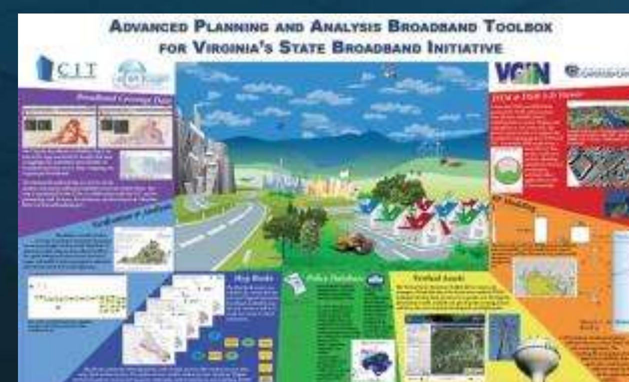
Source	Name	URL	Last Updated	Recurrence	Status	Action
1	US Drought Monitor	http://drought...	06/05/2012 7:00:00 AM	Weekly		Delete



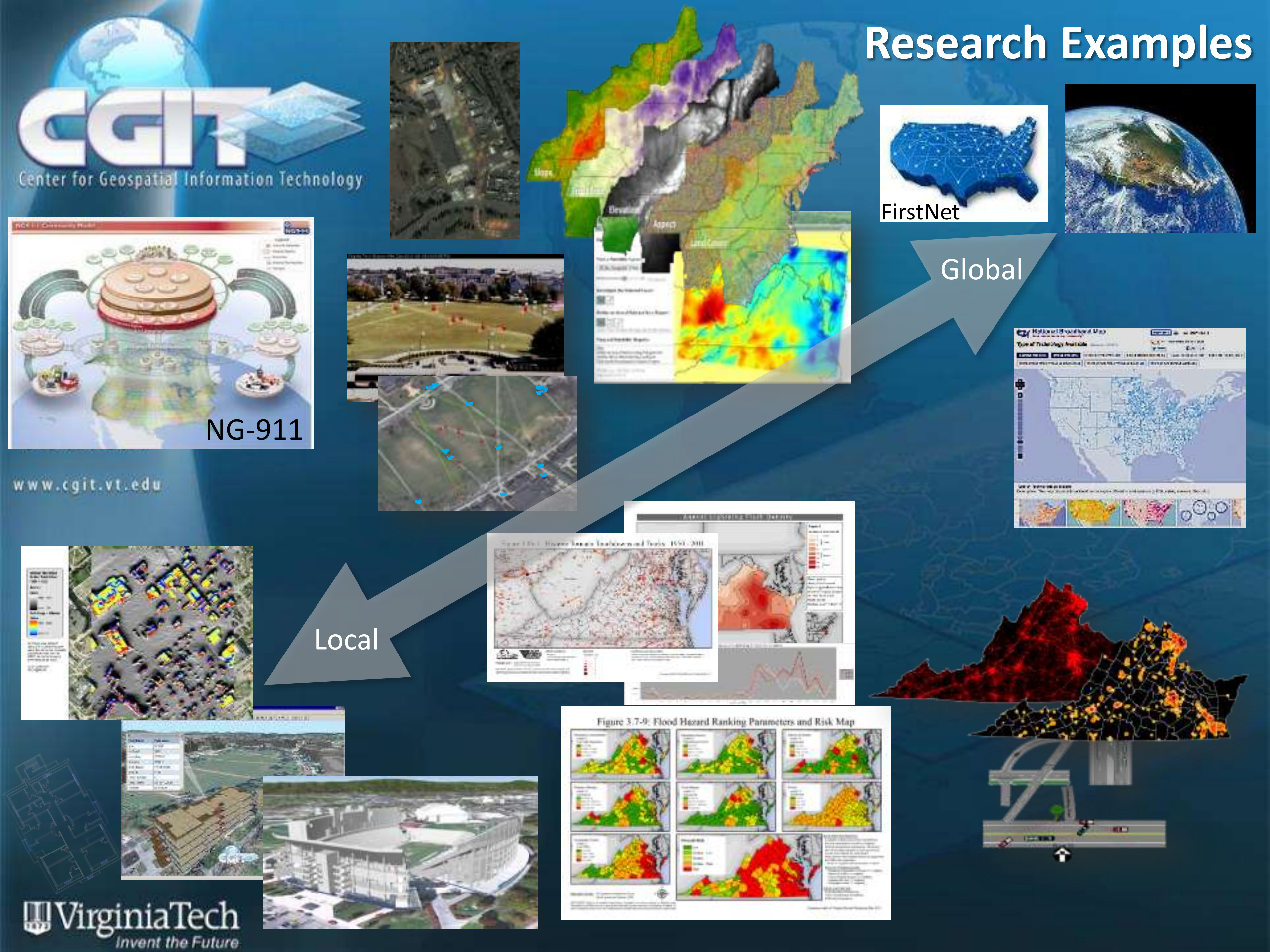




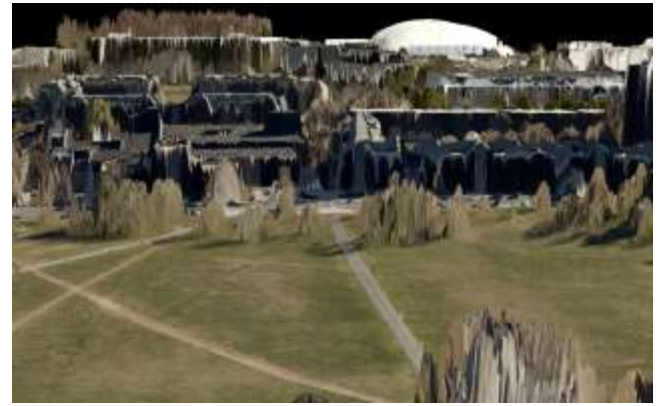




Research Examples



New Statewide Digital Surface Model (DSM) for Virginia from LiDAR and Photogrammetry

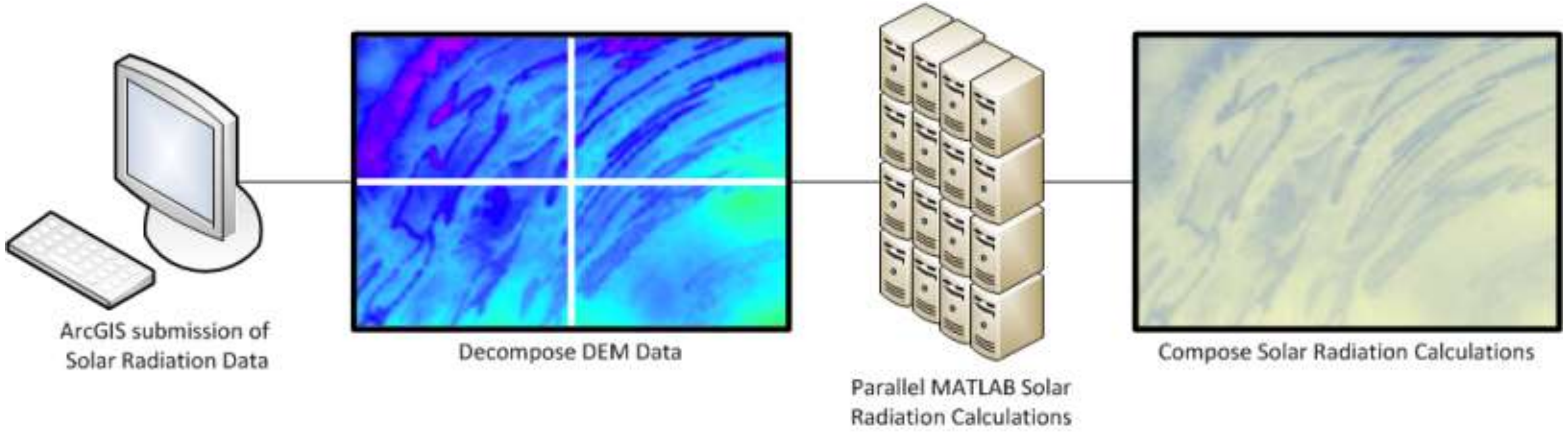


- Proposed by VT-CGIT and VGIN to support development of 3D Spatial Data Infrastructure and the Advanced Broadband Analysis and Planning Toolbox for the Commonwealth of Virginia Broadband Mapping Initiatives
- A digital surface model (DSM) is a digital representation of all natural and artificial features that are visible on the surface of the earth. It includes exposed ground and above –ground features, such as vegetation, buildings and other cultural features. It is useful in geospatial analysis and applications that require line-of-sight, viewshed or vegetation analysis. Applications of DSM data are found in telecommunications, forestry, community planning and renewable energy.
- A statewide DSM for the Commonwealth will be created to support wireless broadband mapping efforts such as vertical assets identification and wireless broadband propagation modeling. The statewide seamless DSM will also provide the basis for analysis and visualization that may support policy and business investment decisions related to broadband and communications infrastructure in the Commonwealth of Virginia.
- As a part of the final product deliverable, a qualitative accuracy assessment will be performed by the DSM developer. This assessment will conform to the National Standard Accuracy (NSSDA) http://www.fgdc.gov/standards/projects/FGDC-standard projects/accuracy/part3/chapter3

Center for Geospatial Information Technology

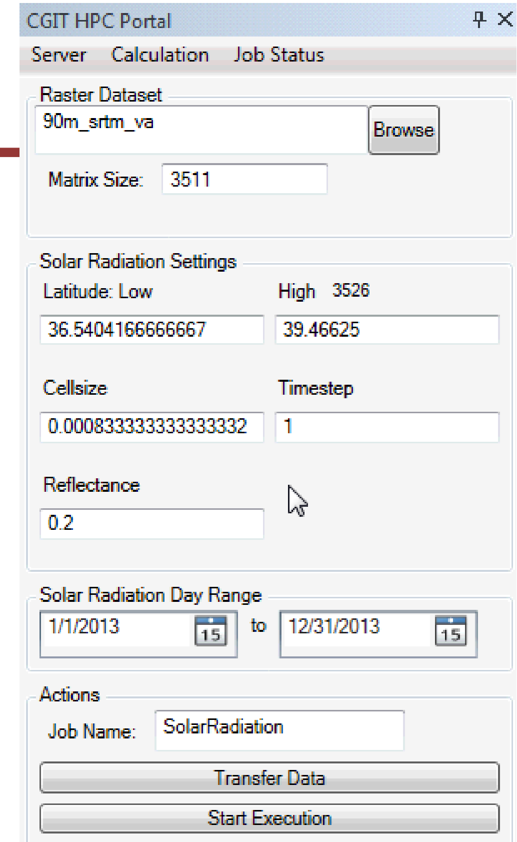
Architecture Overview

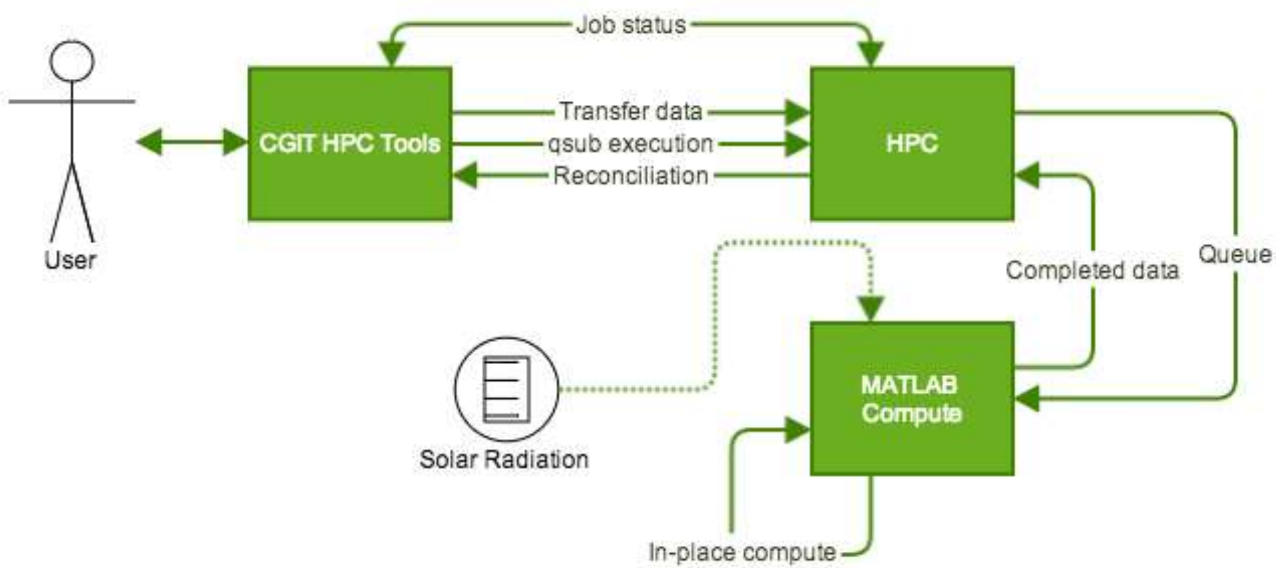
- ESRI C#.NET AddIn
- Parallelized Solar Radiation
  - Felix Hebeler on MATLAB Central File Exchange
  - Parameterized
- SSH and SFTP command line

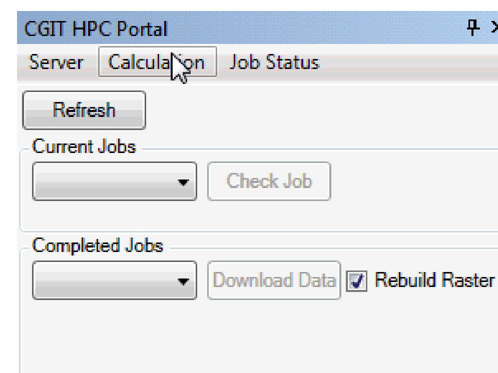


Implementation Overview

- Read and extract raster metadata
- Split raster grid-wise and convert to ASCII GRID
- Transfer data to ARC staging
- Execute qsub job to queue MATLAB computation
- Retrieve job ID and status
- Reconcile and regenerate complete raster







Winter Solstice Solar Radiation (WH / m2)

Terrain

Value

High : 4474

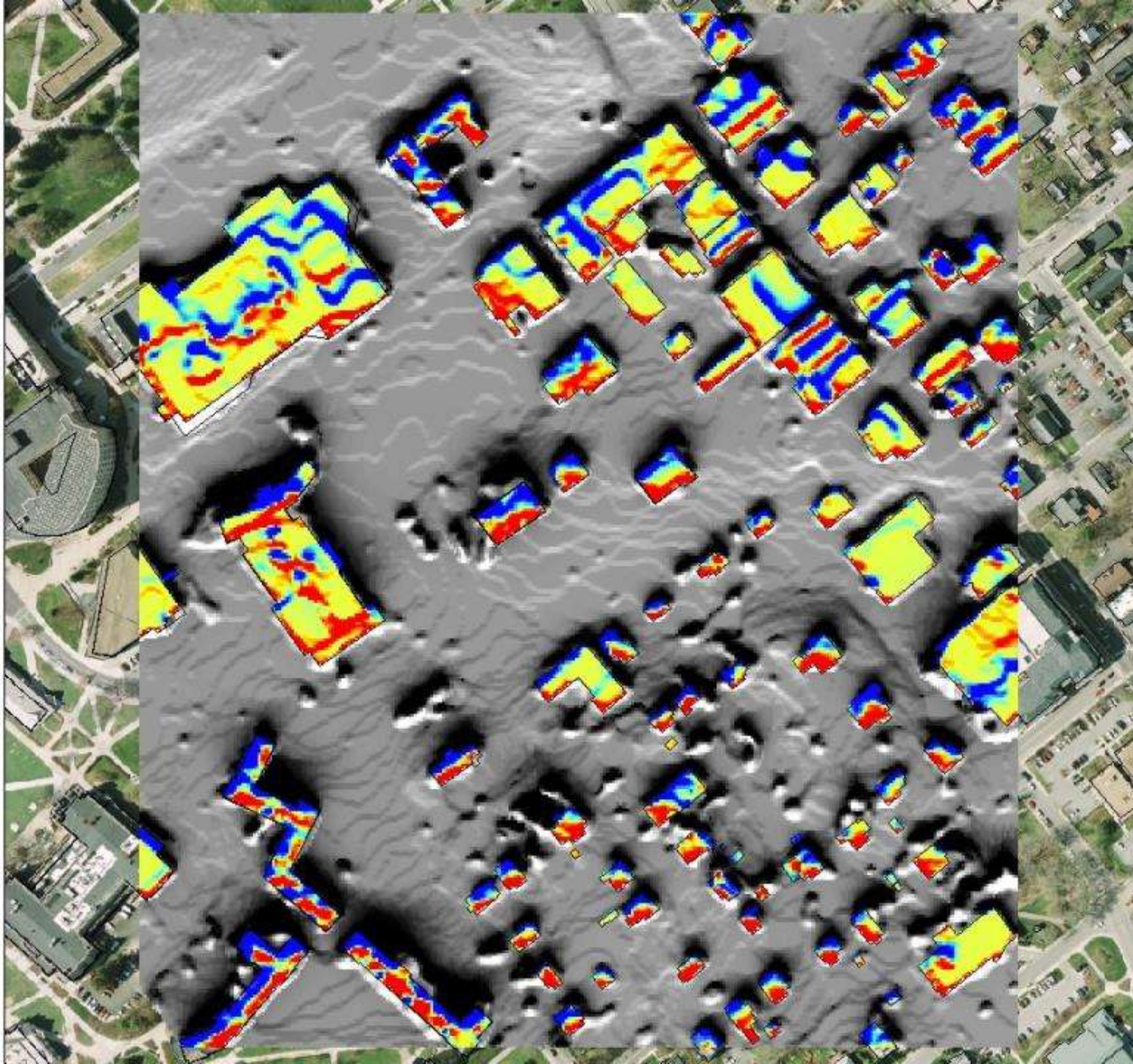
Low : 163

Buildings - Winter

Value

High : 2022

Low : 61



Incoming solar radiation using a 5-m DSM produced using the SimActive Correlator 3D software with the 1-m VBMP stereopair imagery and metadata as input.

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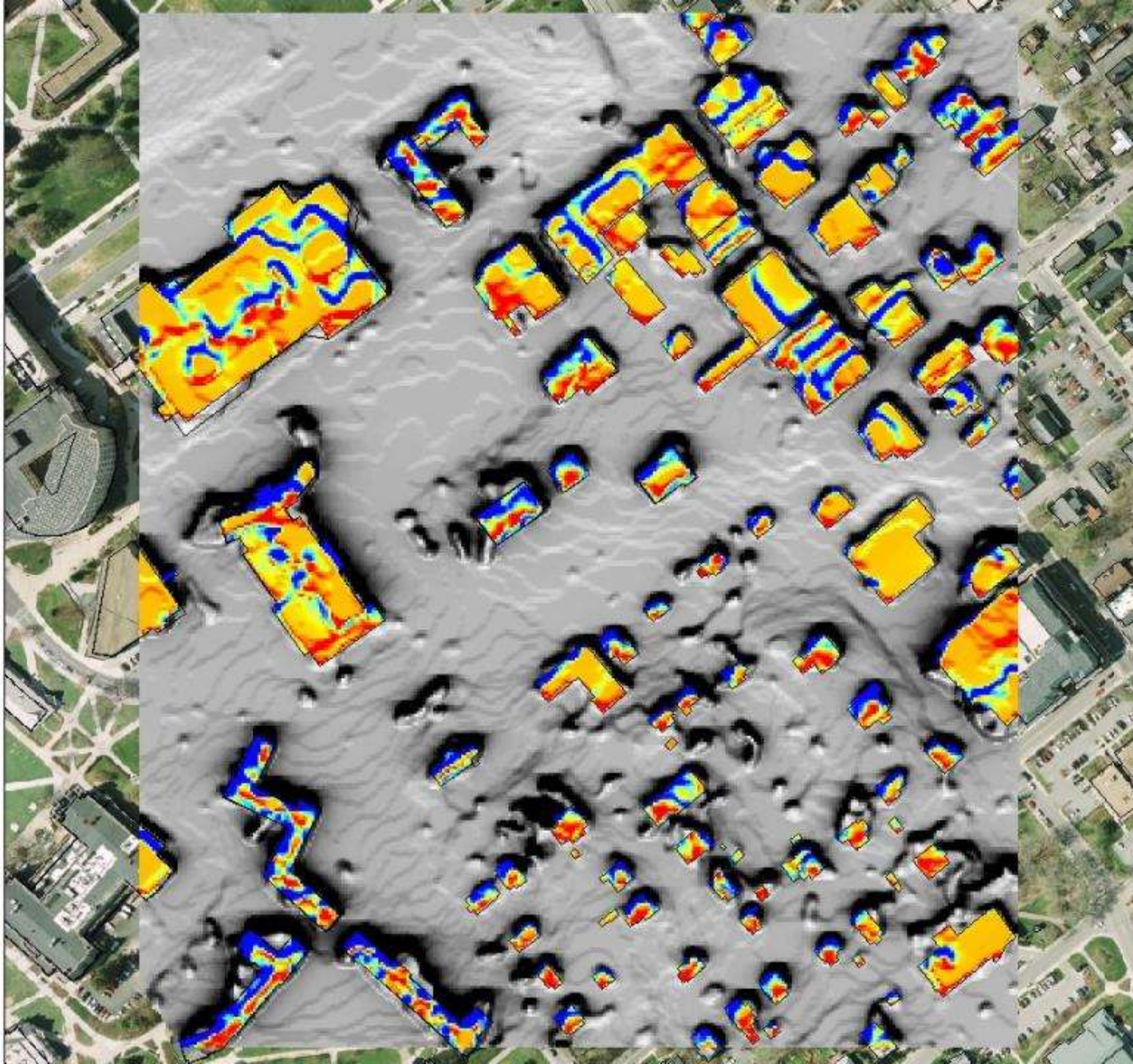
sforza@vt.edu



Equinox
Solar Radiation
(WH / m2)

Terrain

Value

High : 4474

Low : 163

Buildings - Equinox

Value

High : 2022

Low : 61

Incoming solar radiation using a 5-m DSM produced using the SimActive Correlator 3D software with the 1-m VBMP stereopair imagery and metadata as input.

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Summer Solstice Solar Radiation (WH / m2)

Terrain

Value

High : 4474

Low : 163

Buildings - Summer

Value

High : 2022

Low : 61

Incoming solar radiation using a 5-m DSM produced using the SimActive Correlator 3D software with the 1-m VBMP stereopair imagery and metadata as input.

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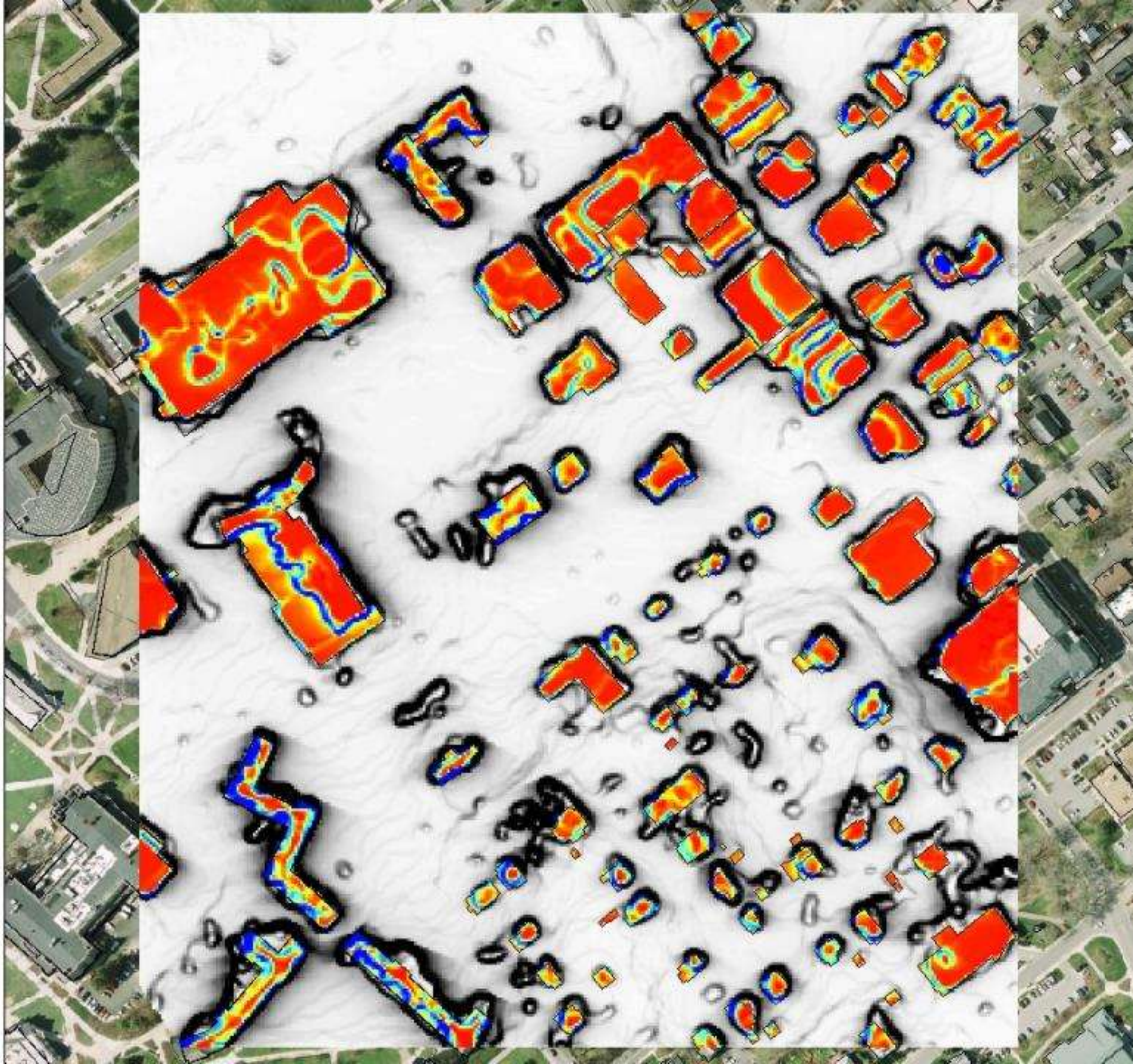
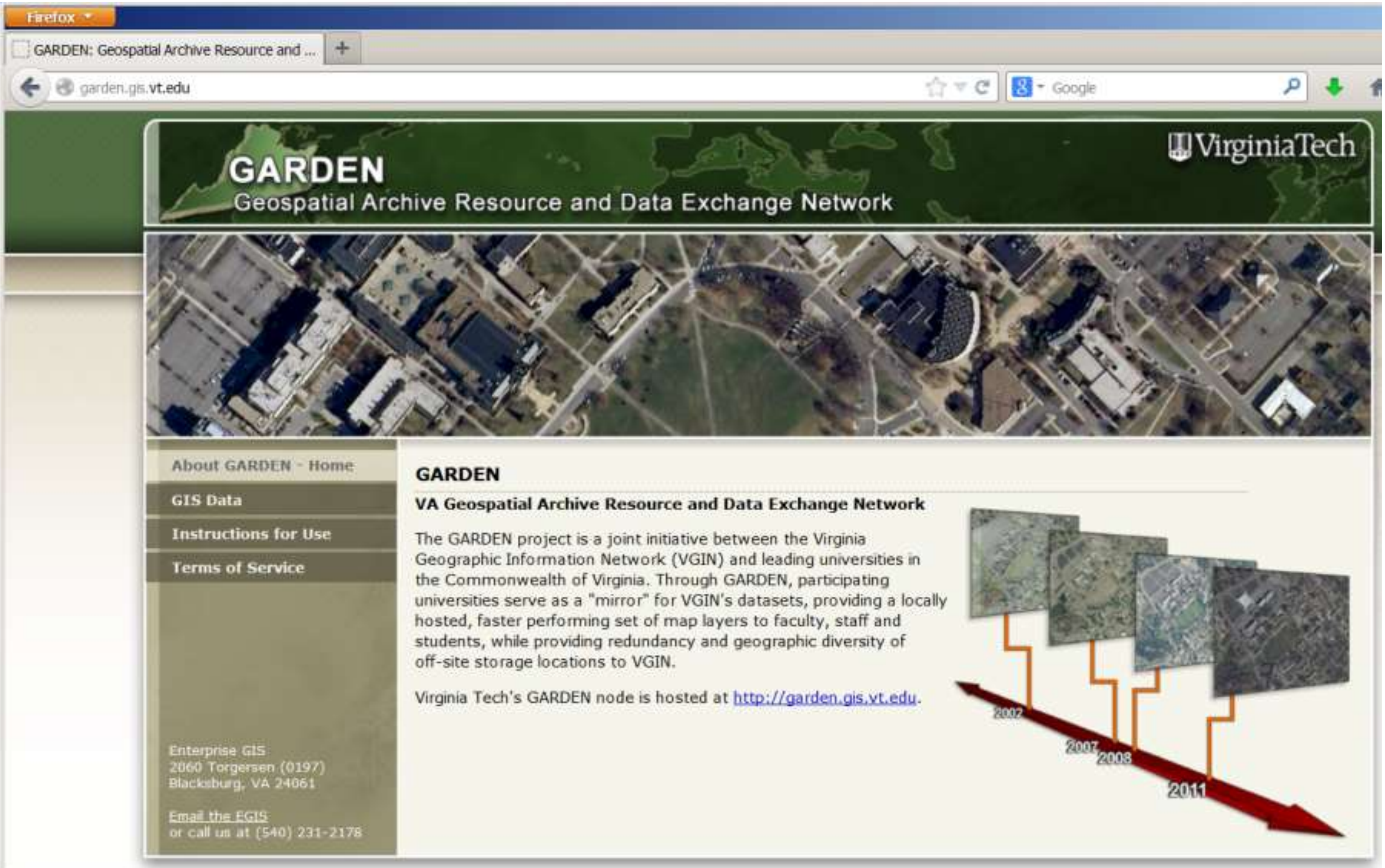


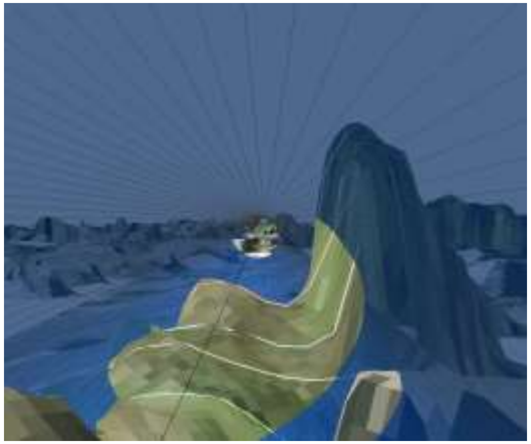

Firefox
GARDEN: Geospatial Archive Resource and ...
garden.gis.vt.edu
Google
GARDEN
Geospatial Archive Resource and Data Exchange Network
VirginiaTech
About GARDEN - Home
GIS Data
Instructions for Use
Terms of Service
Enterprise GIS
2060 Torgersen (0197)
Blacksburg, VA 24061
Email the EGIS
or call us at (540) 231-2178
GARDEN
VA Geospatial Archive Resource and Data Exchange Network
The GARDEN project is a joint initiative between the Virginia Geographic Information Network (VGIN) and leading universities in the Commonwealth of Virginia. Through GARDEN, participating universities serve as a "mirror" for VGIN's datasets, providing a locally hosted, faster performing set of map layers to faculty, staff and students, while providing redundancy and geographic diversity of off-site storage locations to VGIN.
Virginia Tech's GARDEN node is hosted at http://garden.gis.vt.edu.
2002
2007
2008
2011

Advanced Planning and Analysis Broadband Toolbox for Virginia's State Broadband Initiative

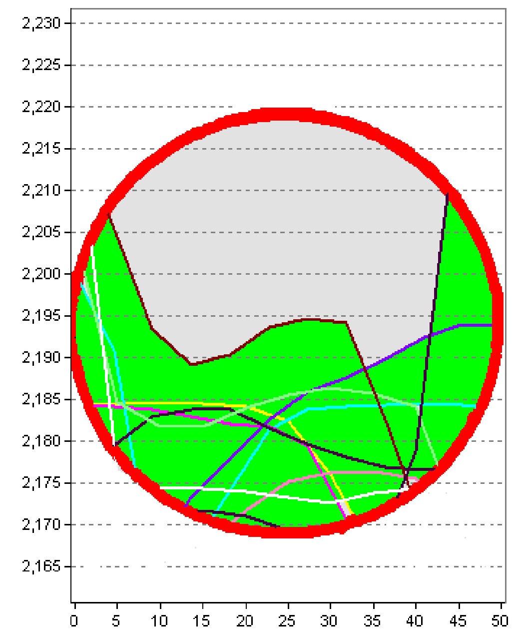
VirginiaTech
Invent the Future

Microwave Transmission Corridor Mapping and Analysis

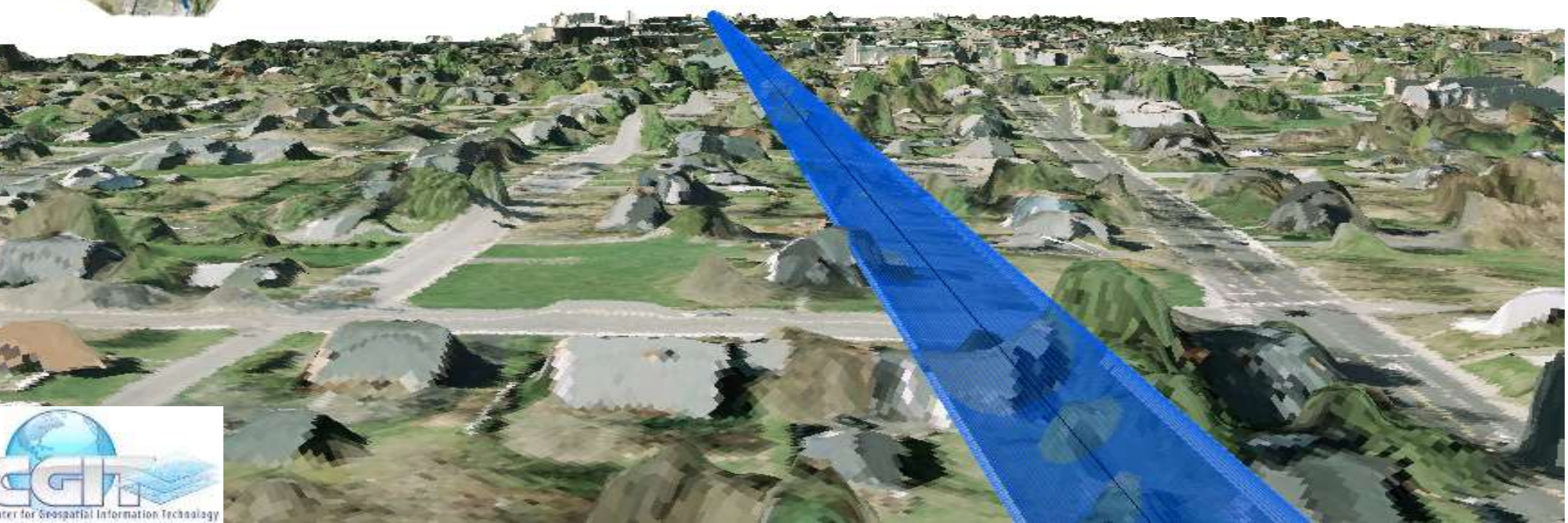
Peter Sforza, Thomas Dickerson, Matej Muza
CGIT Virginia Tech - May 2011

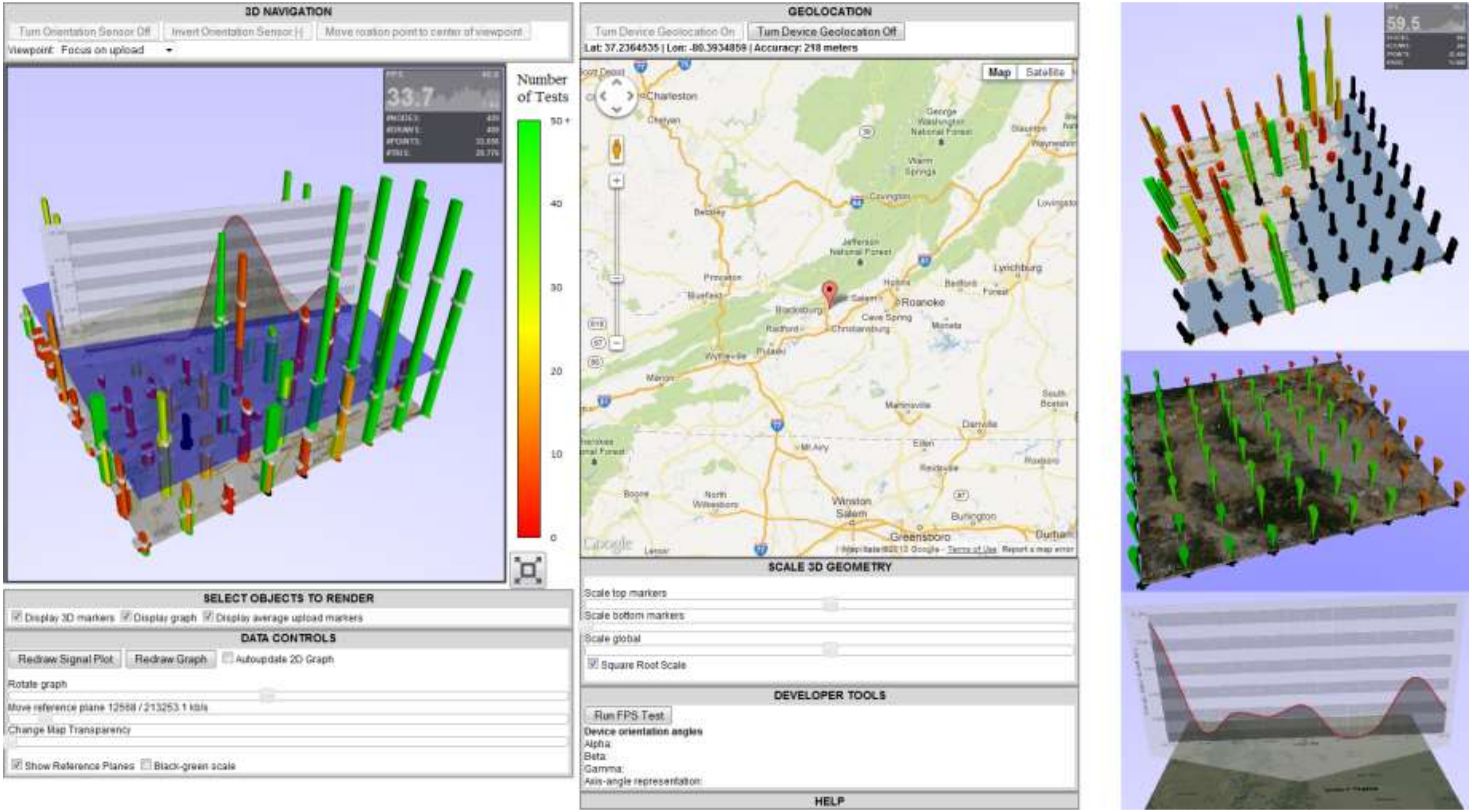


Analysis using TINs:
Volume = 248966.77 ft3; 3DArea = 51005.54 ft2; 2DArea = 31429.18 ft2



Sample of 10 cross-sectional profiles of corridor obstructions



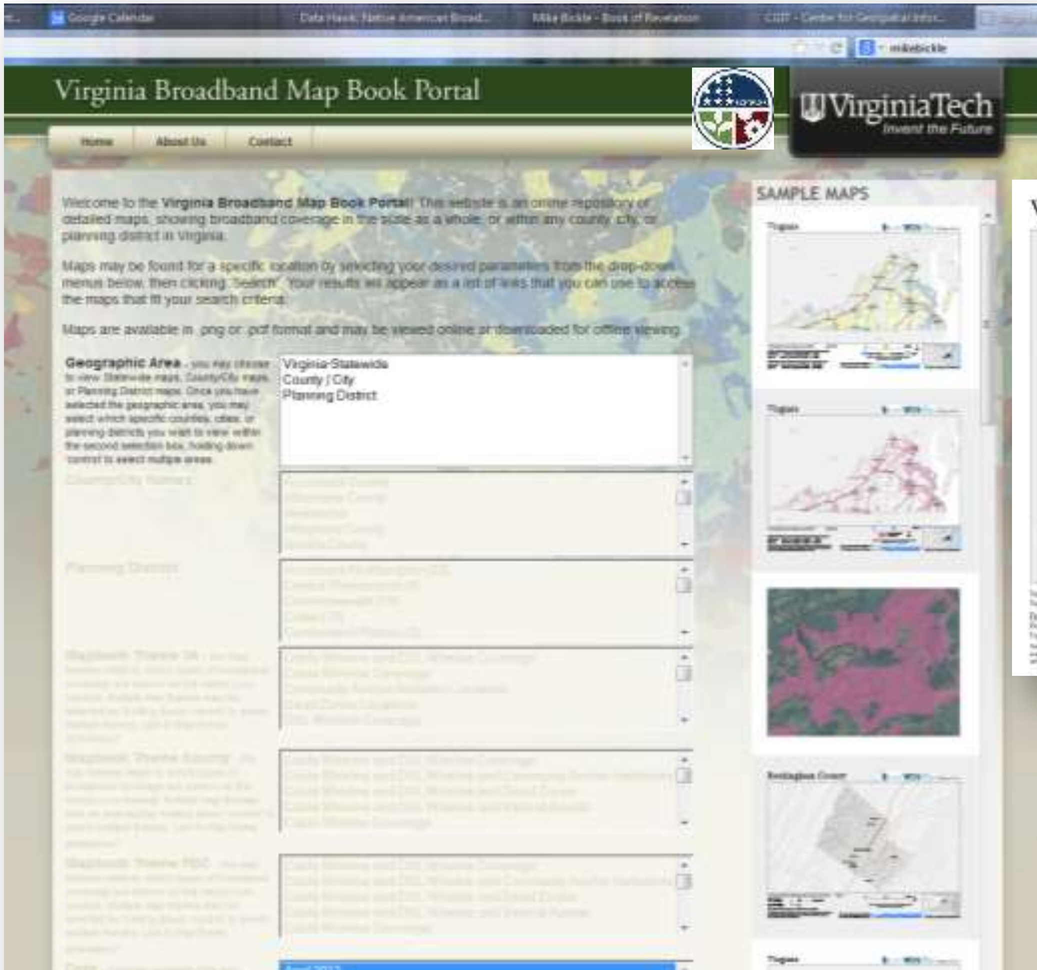


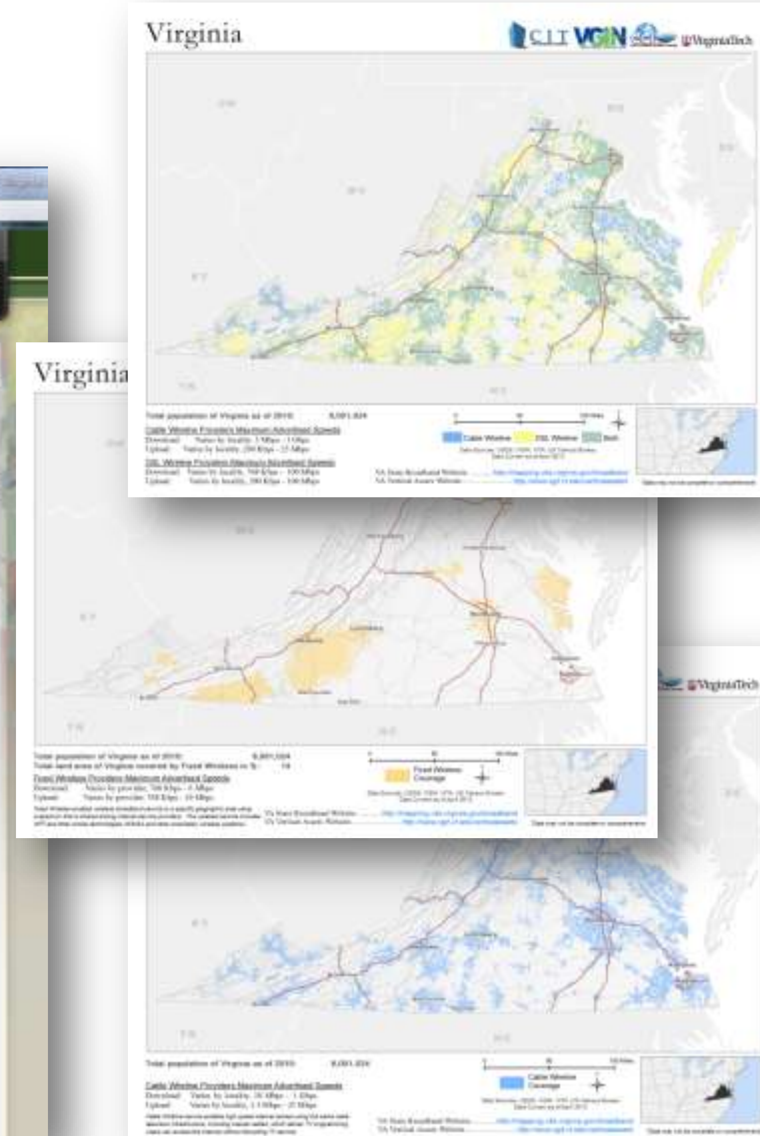
User interface, left, and various display options for maps and broadband visualization, right
SpeedSpy – Sharakhov et al (2013) http://dl.acm.org/citation.cfm?id=2534931

Broadband Planning and Analysis Toolkit Demos

1 – Broadband Mapbook Portal:

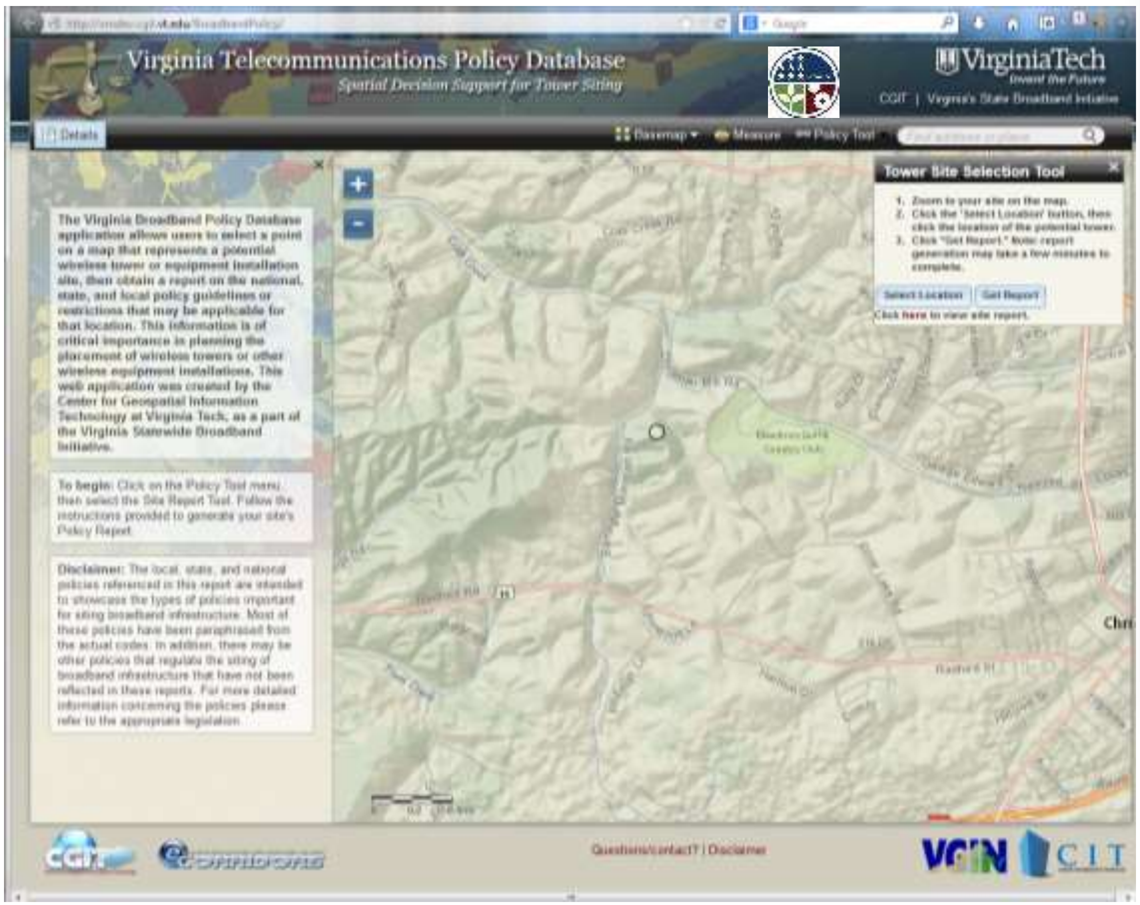
http://www.youtube.com/watch?v=pzt0-29InLQ

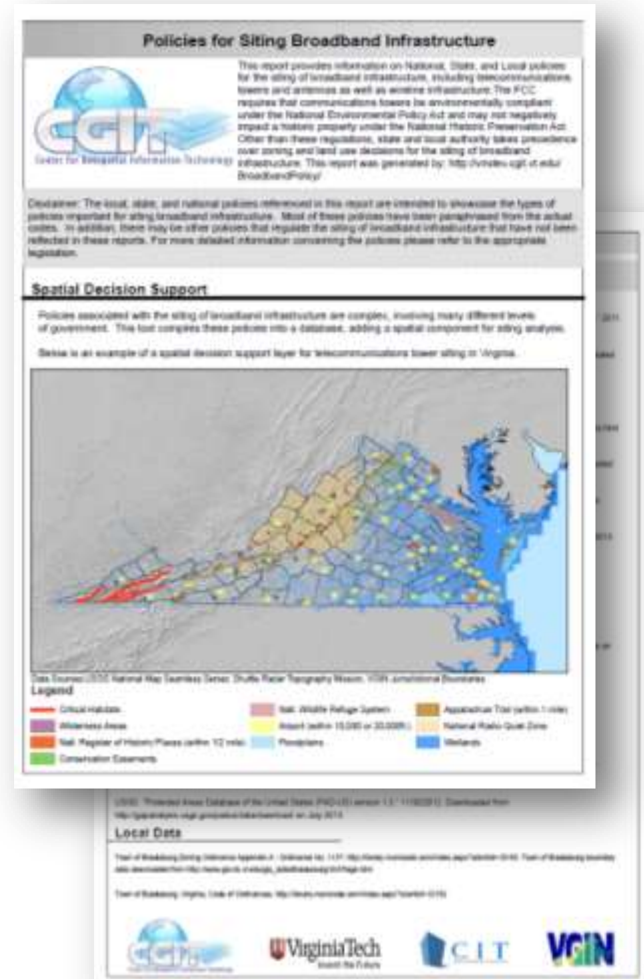




Broadband Planning and Analysis Toolkit Demos

2 – Broadband Policy Database: Generates a report based on user-selected location. The report highlights policies at multiple jurisdictional levels that may affect broadband deployment at that location.





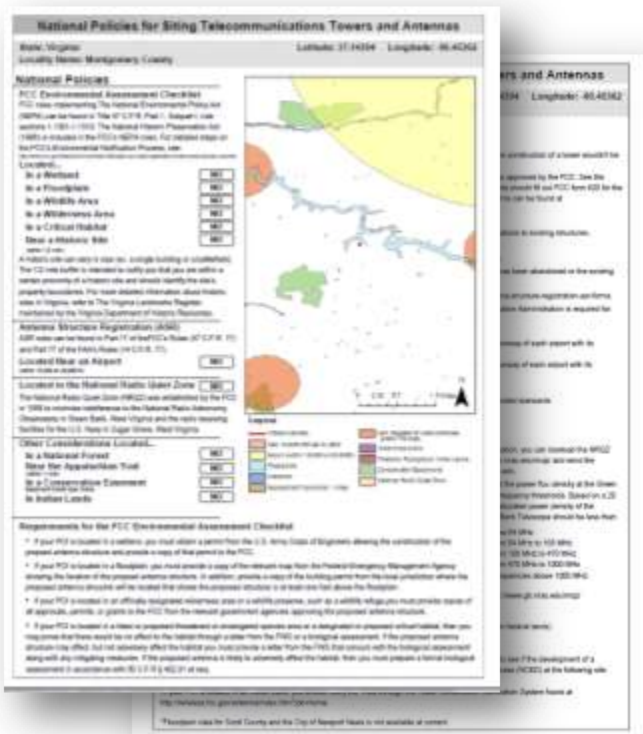
Broadband Planning and Analysis Toolkit Demos

2 – Broadband Policy Database:

Related policy information and maps are found inside the report.

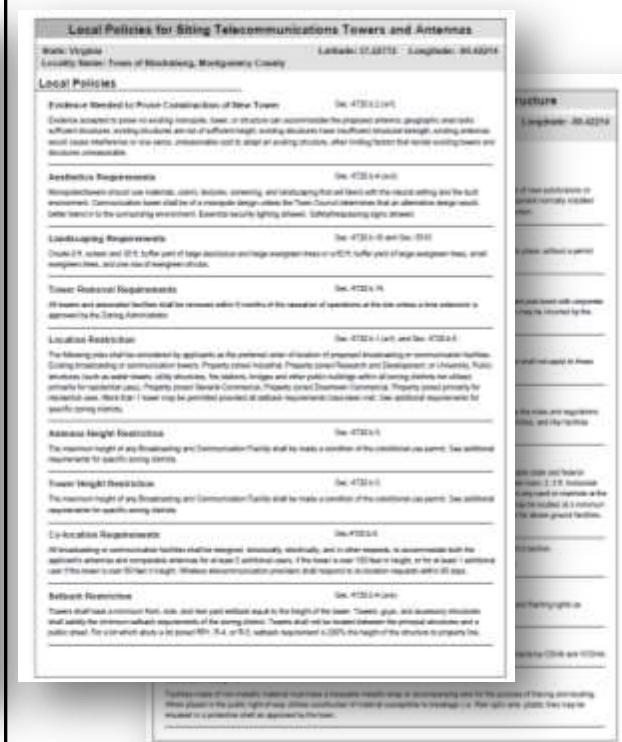
http://www.youtube.com/watch?v=FWOTvmMMU0M

National Policies



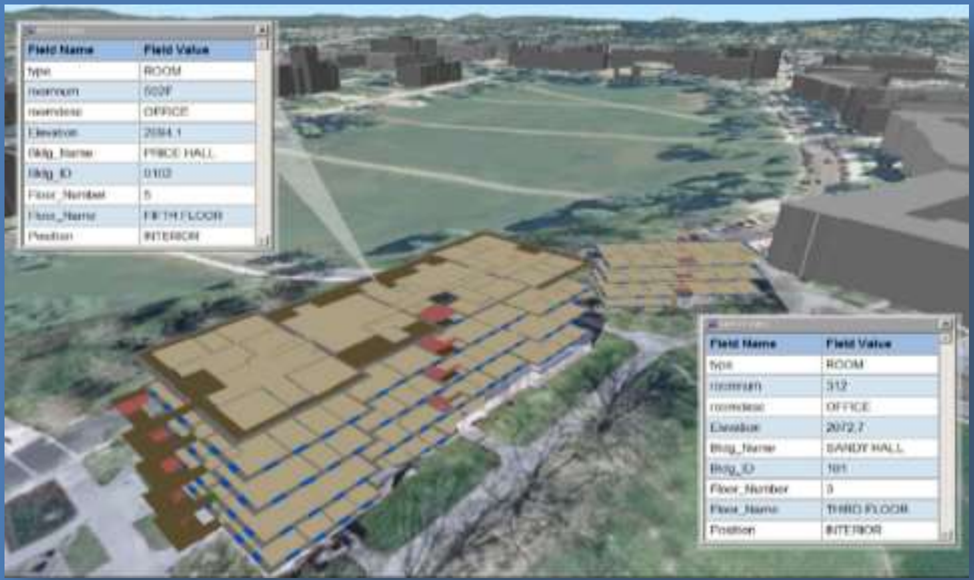
States Policies

Local Policies



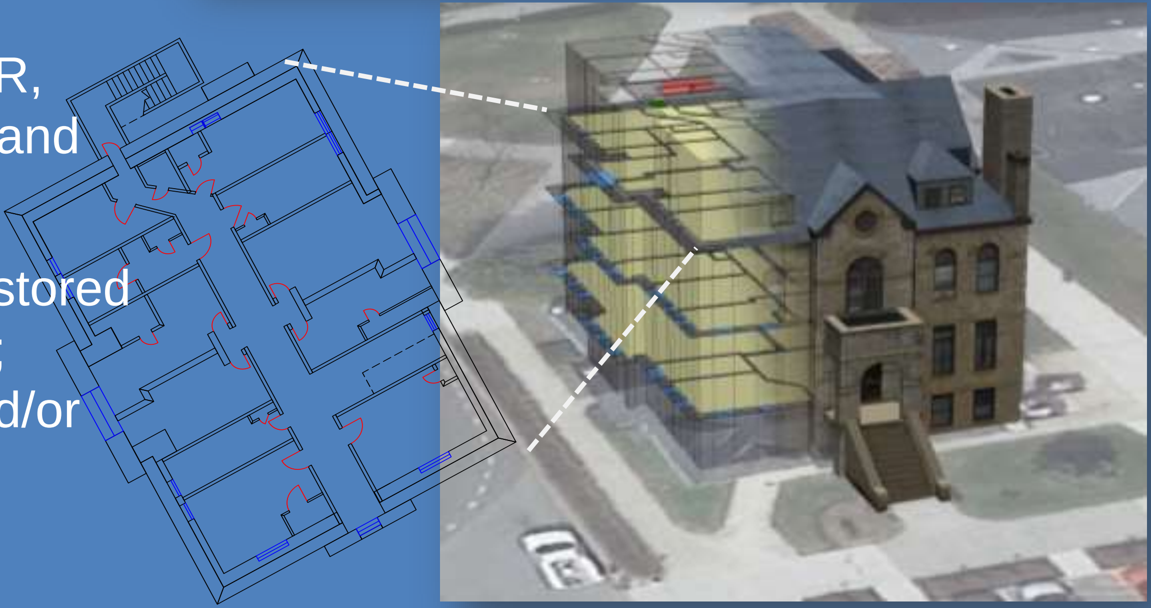
Selected Project: Campus Interior Space

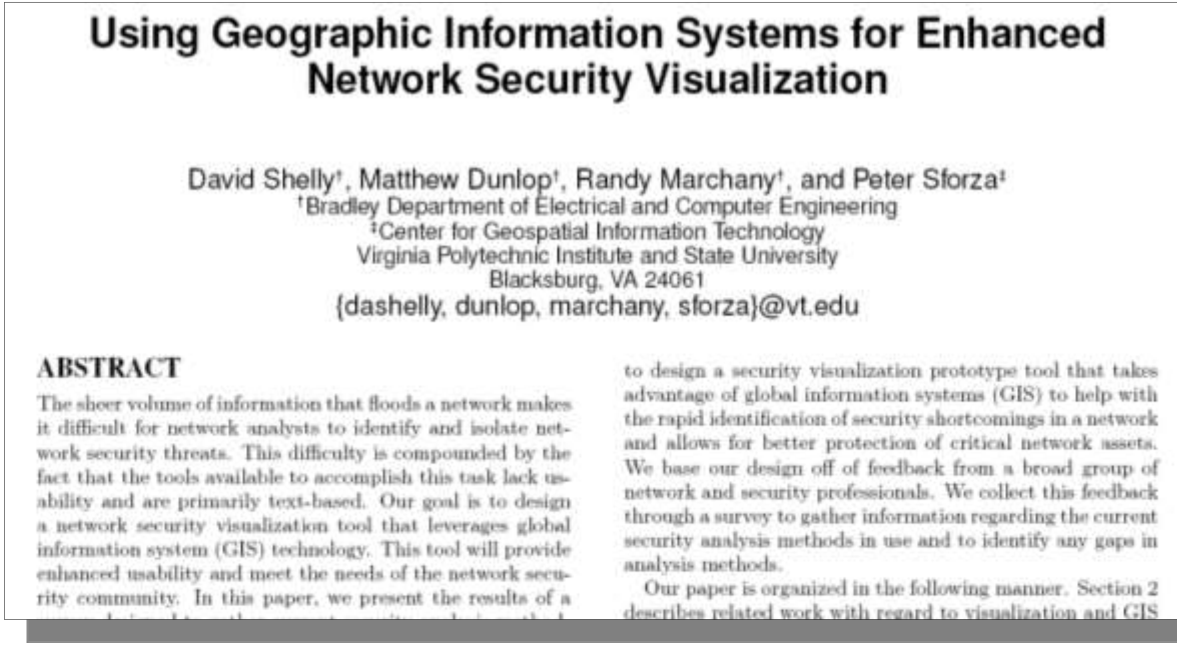
The campus interior space project was initiated to provide a foundation for campus-wide space management, indoor navigation, safety, and other applications.



Spatial representations of building interiors and exteriors are created using CAD floorplans, orthophotography, aerial LiDAR, close-range photogrammetry, and other reference data.

The results of this project are stored in an enterprise geodatabase; authorized users may view and/or edit the dataset.





Using Geographic Information Systems for Enhanced Network Security Visualization

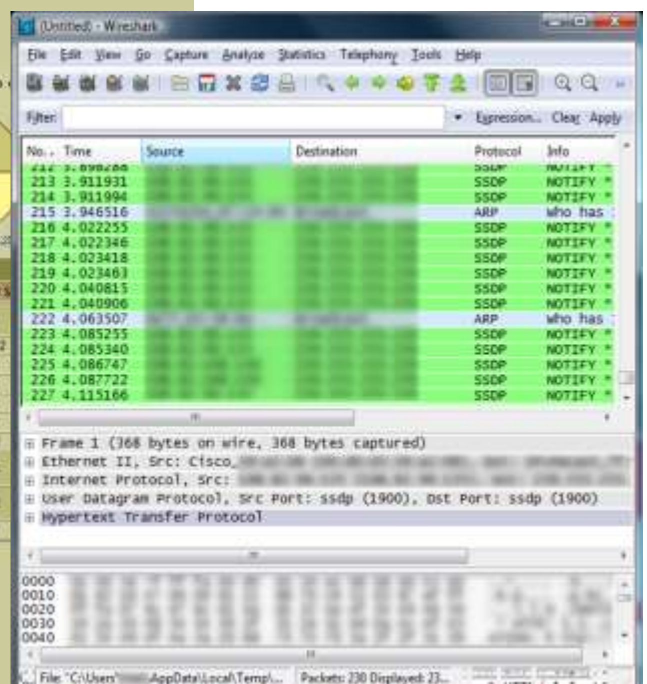
David Shelly[†], Matthew Dunlop[†], Randy Marchany[†], and Peter Sforza[‡]
[†]Bradley Department of Electrical and Computer Engineering
[‡]Center for Geospatial Information Technology
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061
{dashelly, dunlop, marchany, sforza}@vt.edu

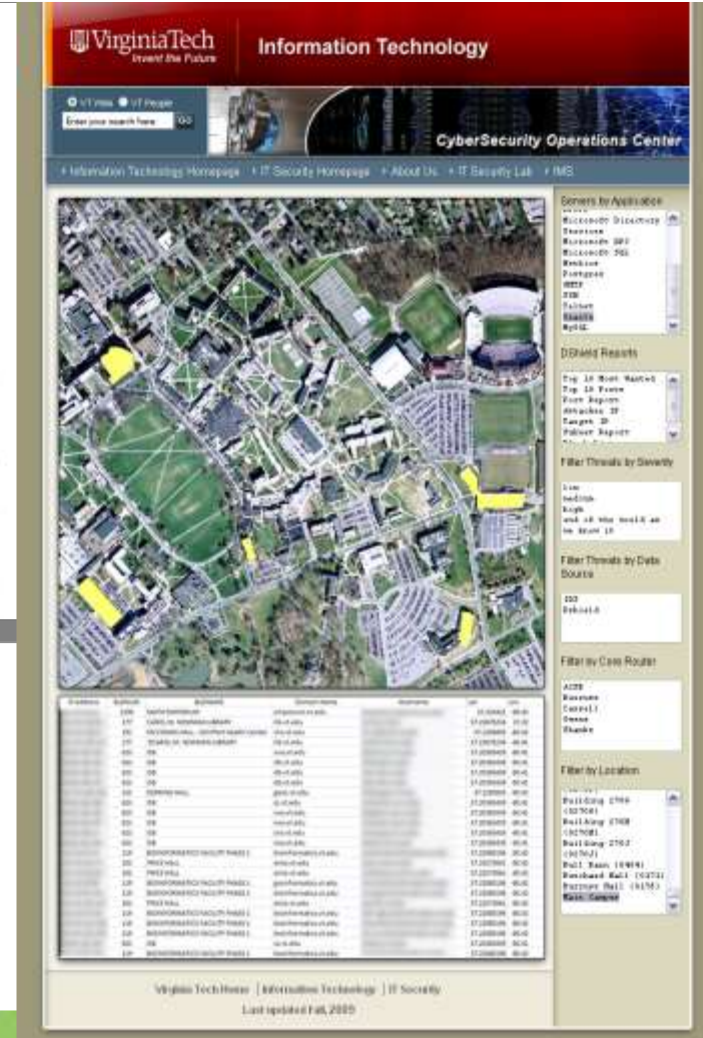
ABSTRACT

The sheer volume of information that floods a network makes it difficult for network analysts to identify and isolate network security threats. This difficulty is compounded by the fact that the tools available to accomplish this task lack usability and are primarily text-based. Our goal is to design a network security visualization tool that leverages global information system (GIS) technology. This tool will provide enhanced usability and meet the needs of the network security community. In this paper, we present the results of a

to design a security visualization prototype tool that takes advantage of global information systems (GIS) to help with the rapid identification of security shortcomings in a network and allows for better protection of critical network assets. We base our design off of feedback from a broad group of network and security professionals. We collect this feedback through a survey to gather information regarding the current security analysis methods in use and to identify any gaps in analysis methods.

Our paper is organized in the following manner. Section 2 describes related work with regard to visualization and GIS





3D Blacksburg

- Web-published GIS and 3D collections, services
- Standards-based, cross-platform web visualization
- Internal and public (CC-A) use versions
- Goals:
  - A vibrant, engaged and informed community
  - A durable and interoperable platform with which to conduct studies on planning, environment, energy, safety, transportation and economy

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Center for Geospatial Information Technology

X3D VT

VirginiaTech
Invent the Future


http://www.3DBlacksburg.org/
3D Blacksburg
collaborative
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Learn
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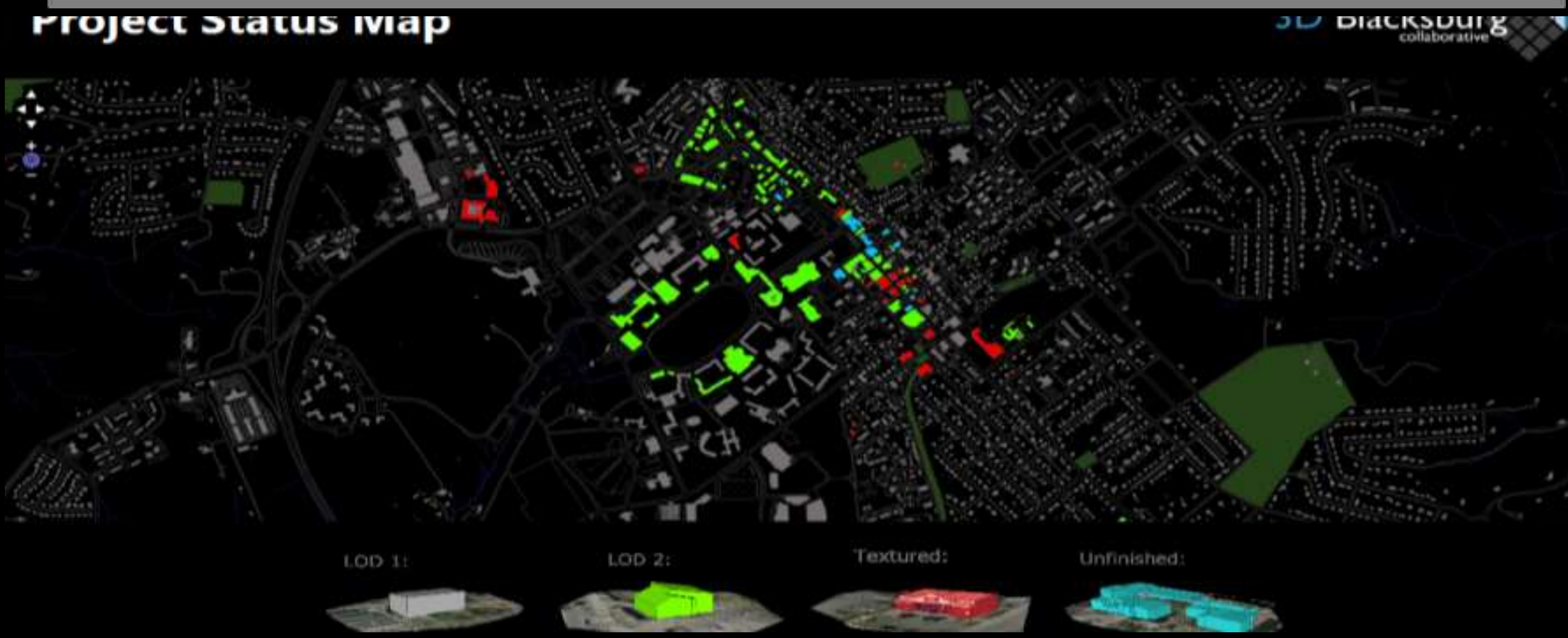
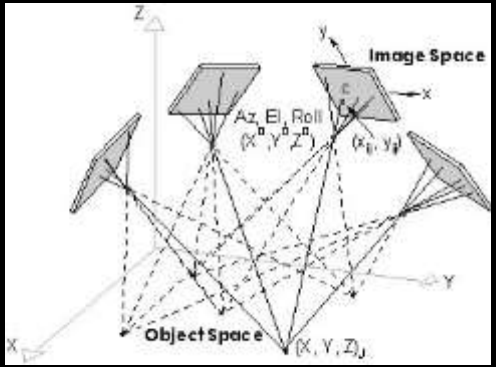

LOD 1:
LOD 2:
Textured:
Unfinished:

Interior-Exterior *Geometric* and *Information Model* Convergence

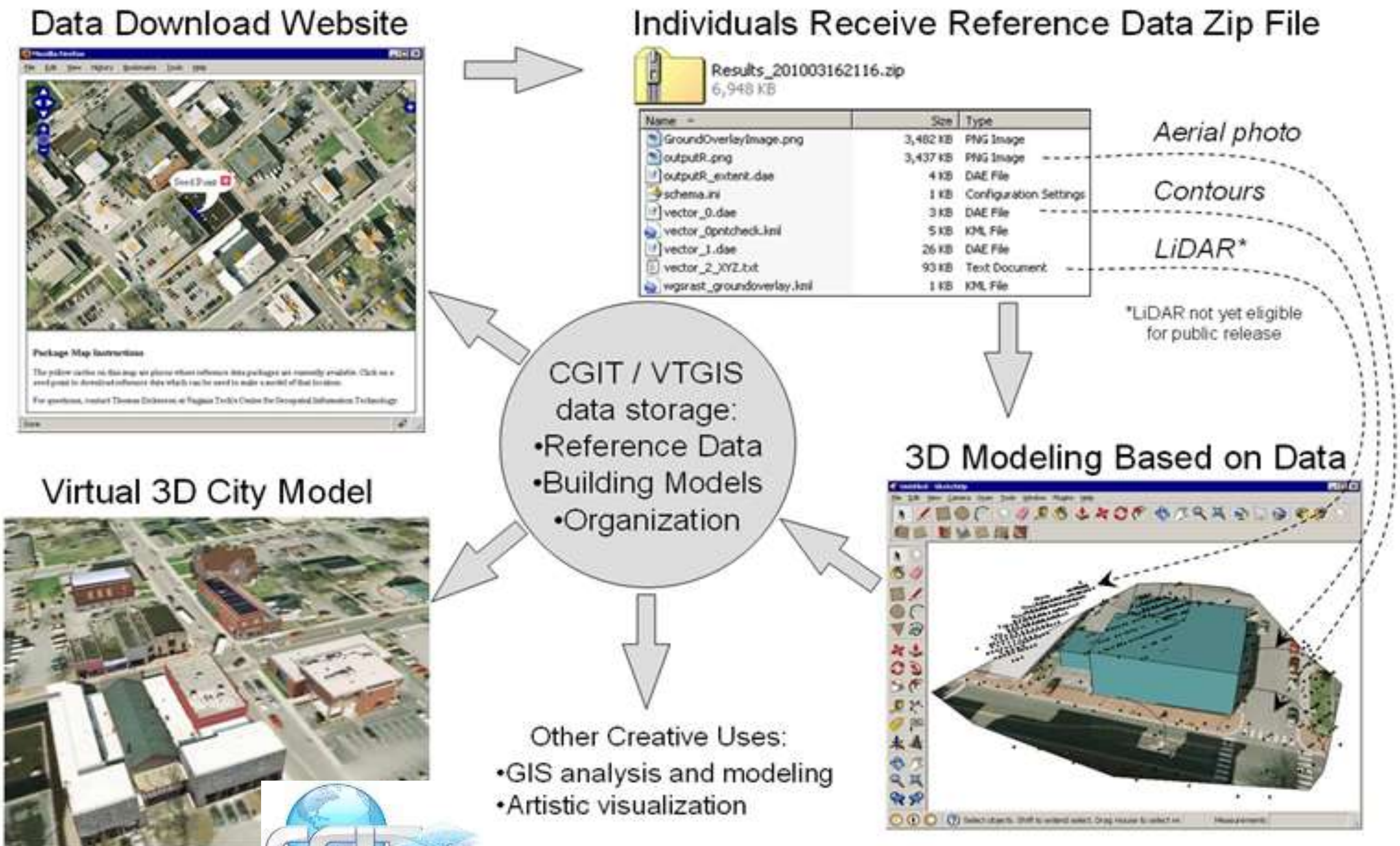
3D Modeling Workflows

Bundle adjustment from 34 photos
– using Canon Rebel Ti
Initial results for Virginia Tech
Performing Arts Building



http://www.geodetic.com/Whatis.htm

Collaborative 3D City Modeling

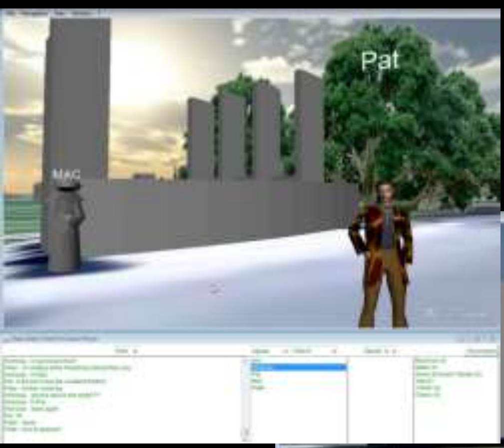


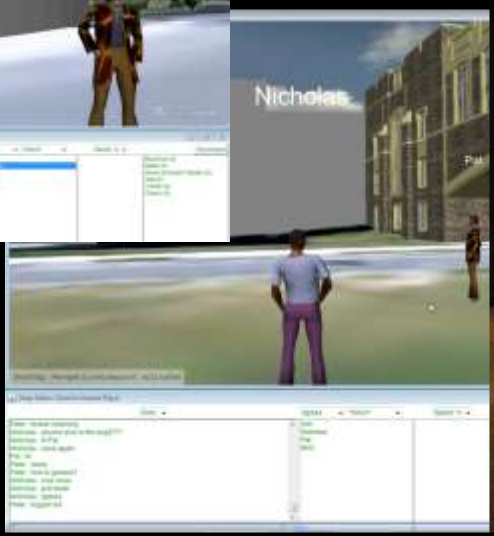
CGIT Center for Geospatial Information Technology

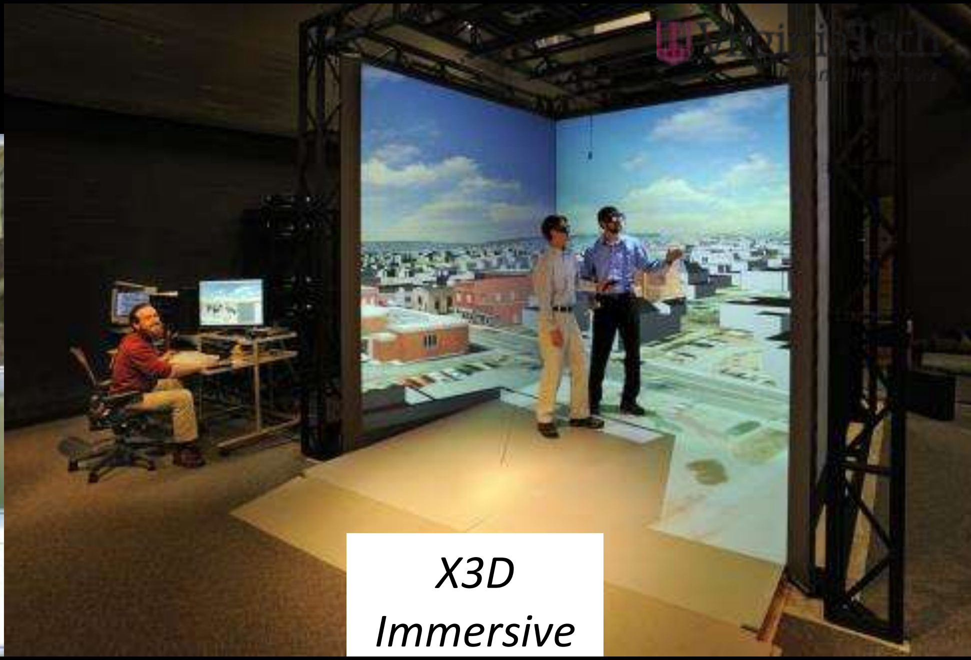
http://www.3dblacksburg.

3D Blacksburg

Town & Building LODs







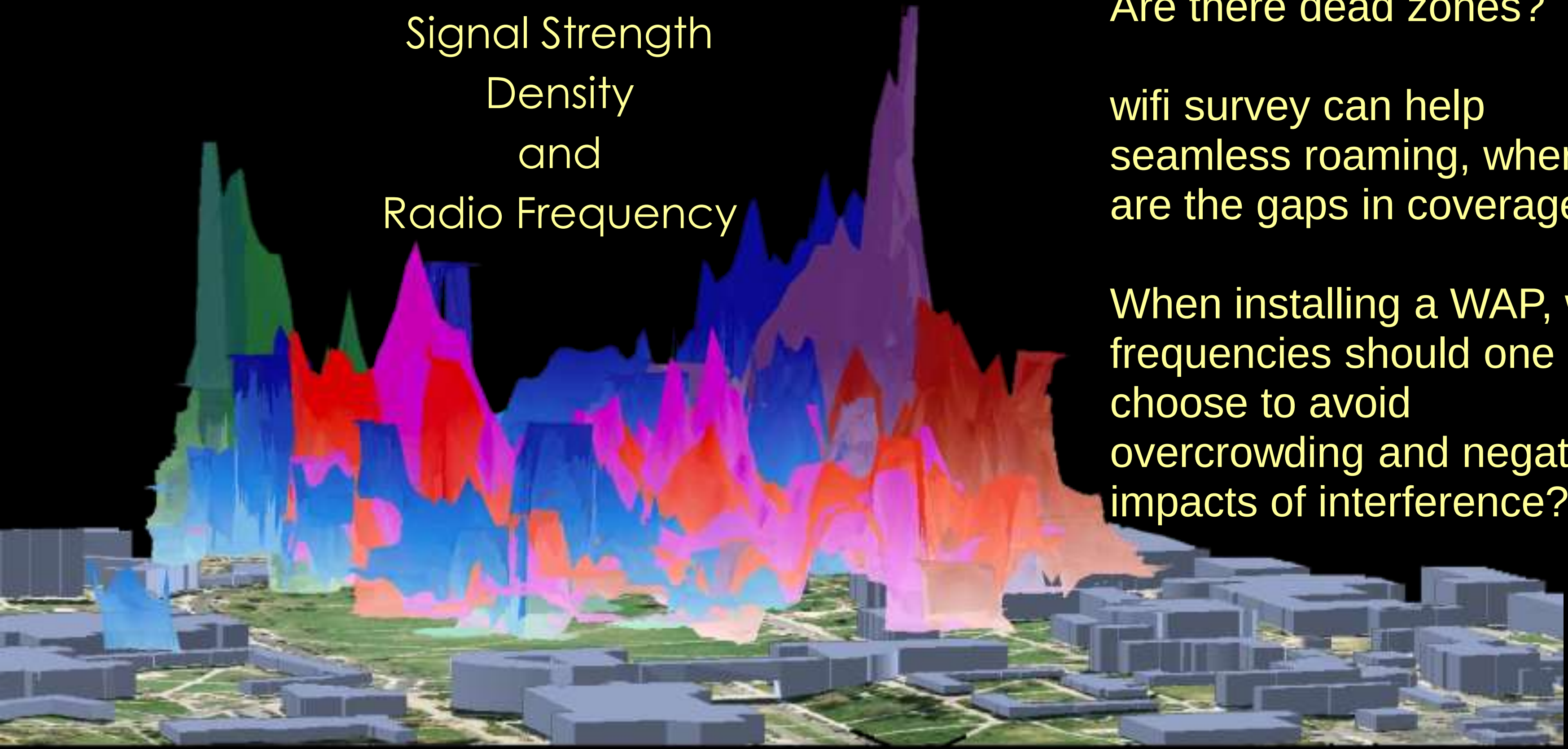
X3D Immersive

X3D shared multi-user VT Campus

[C:\Users\Peter\Documents\3D_Blacksburg\presentations\Multi-User-](C:\Users\Peter\Documents\3D_Blacksburg\presentations\Multi-User-)

WiFi Signal Mapping

2D and 3D Interpolations:
Signal Strength
Density
and
Radio Frequency



where can I get wifi access?
Are there dead zones?

wifi survey can help seamless roaming, where are the gaps in coverage?

When installing a WAP, what frequencies should one choose to avoid overcrowding and negative impacts of interference?

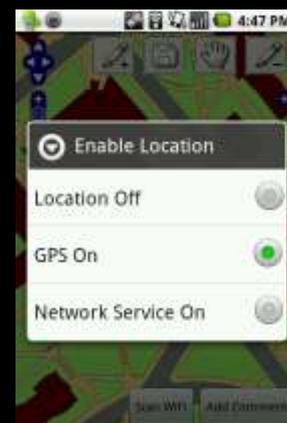
Interior location and navigation

Network security diagnostics and forensics.

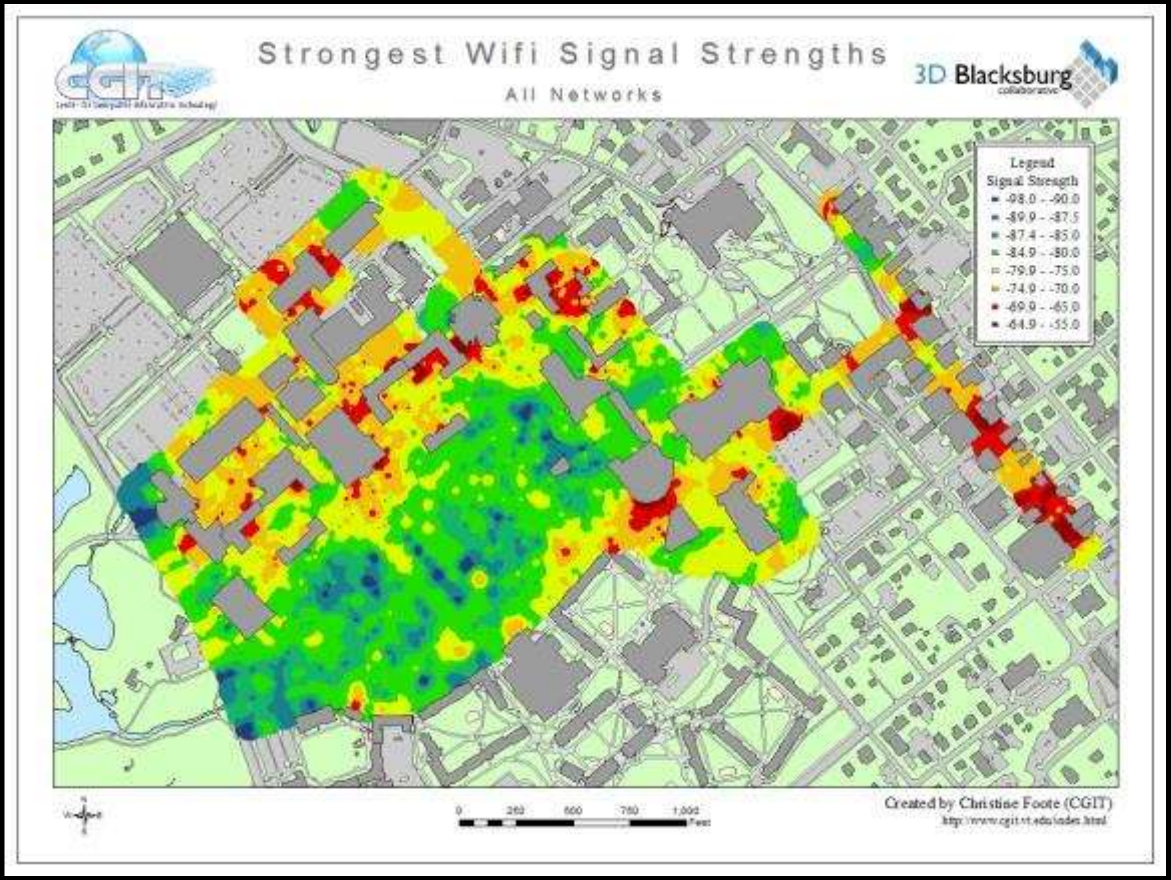
Identify anomalies such as rogue networks, or networks that violate FCC regulations.

WIFI Scanner Application (Android)

Set scan mode to "Dual Scan", enable GPS, zoom in, pinpoint location, initiate the scan, repeat



All Networks: Best Signal Strengths

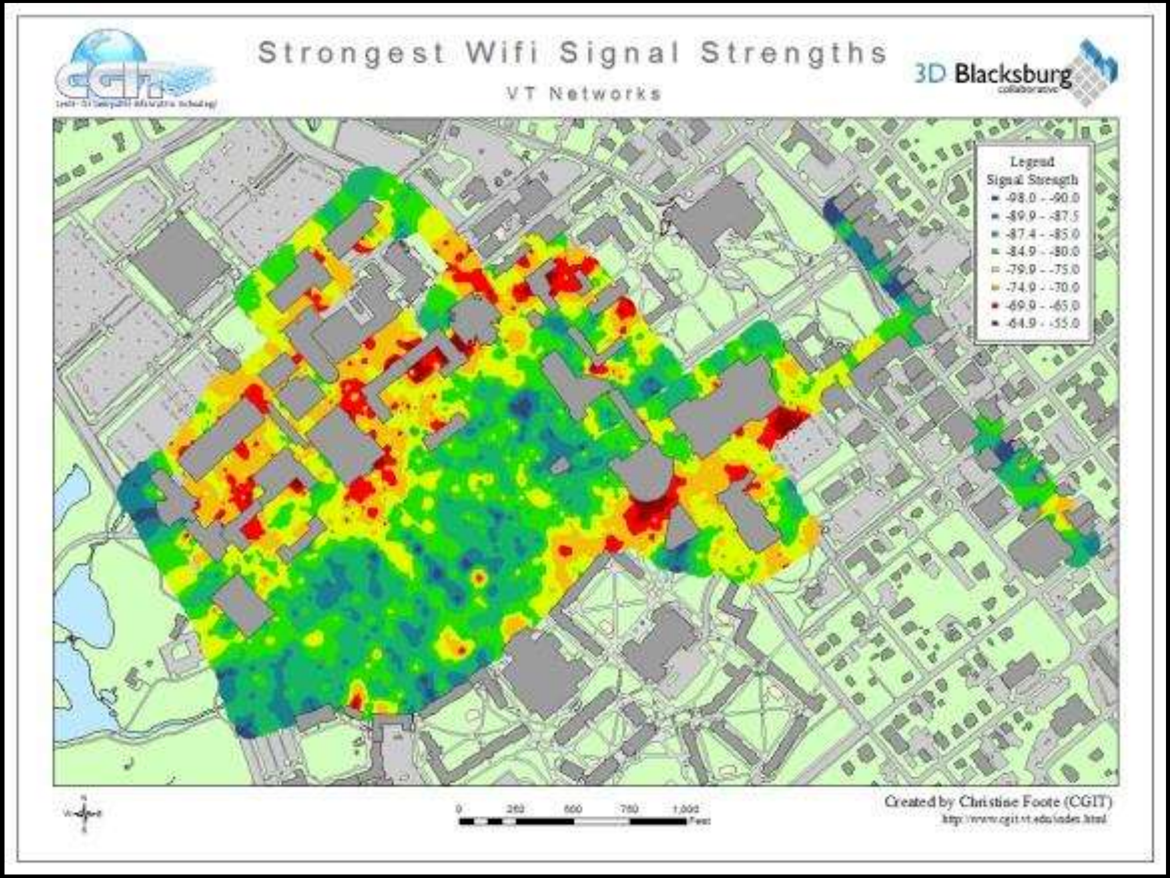


This map displays the strongest signal strength viewed at each scan location, regardless of its network, security type or channel.

Throughout the Drillfield and continuing on toward Alumni Mall, signals are weak. The southern end of main street shows the largest areas of very good signal strength.

On this map, there are two spots of strong signals that can likely be attributed to large windows in nearby buildings. The first is the area just outside of Newman Library's café, and the second fans out of Squires' main entrance on College Ave.

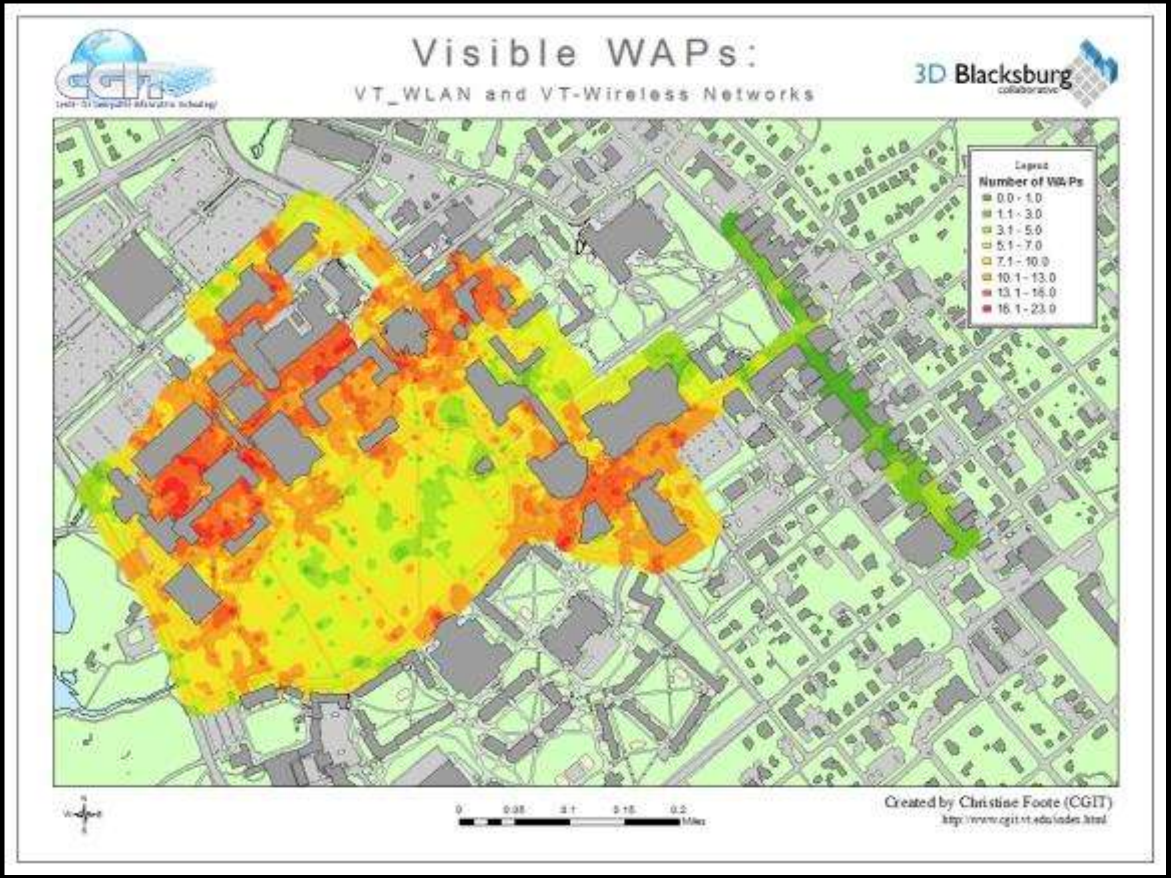
Combined VT Networks



This map shows the maximum signal strength visible at each scan location for the VT_WLAN and VT-Wireless networks. The strongest signals here are located very close to the buildings on campus. The Drillfield, Mall, and Main Street have much weaker signal strengths, though further south along Main Street the strength increases.

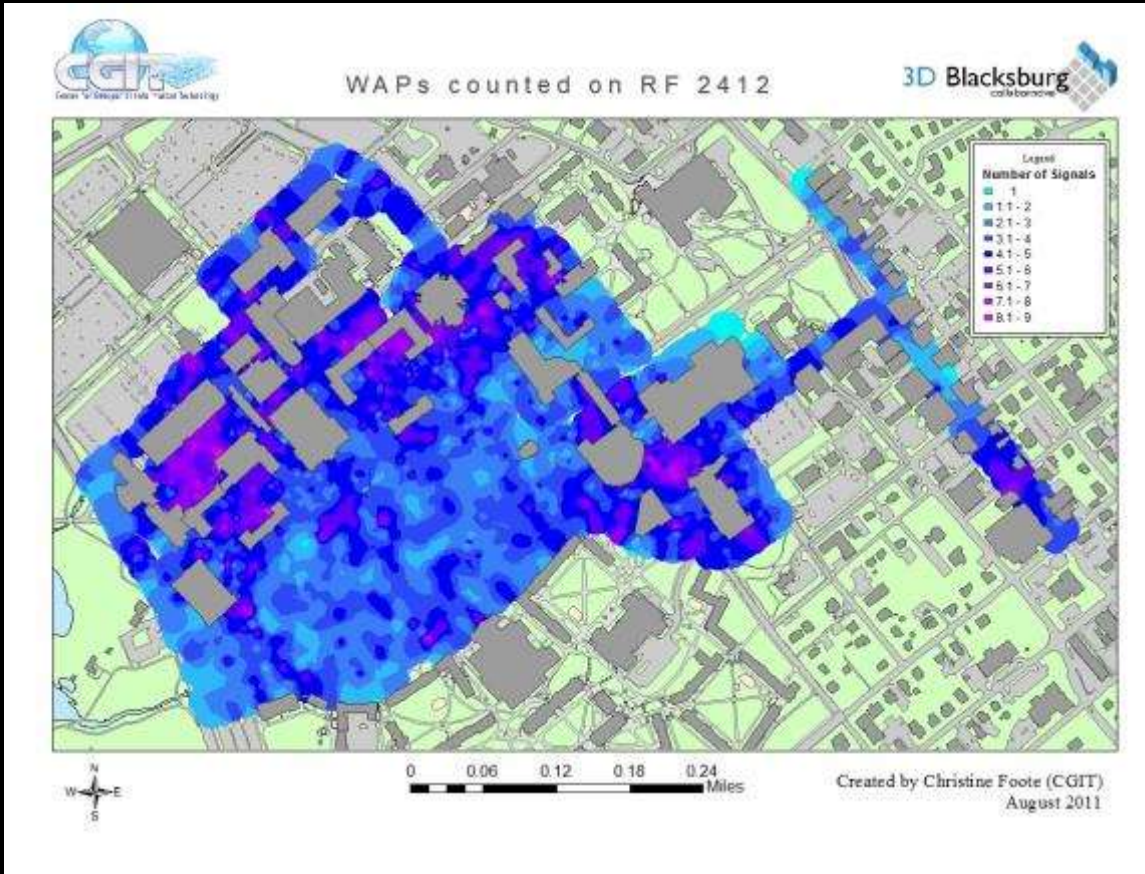
Number of WAPs: VT Networks

This map depicts the number of wireless access points counted at each scan location for both the VT_WLAN and VT-Wireless Networks. While no or very few signals were visible along Main Street, the most are seen between buildings in the northern part of campus, as well as in the vicinity around the bookstore, reaching up to 23 signals detected in a single location. The Drillfield, Torgerson and Brodie Halls, as well as the mall do tend to see signals, though on average less than 10 per location.



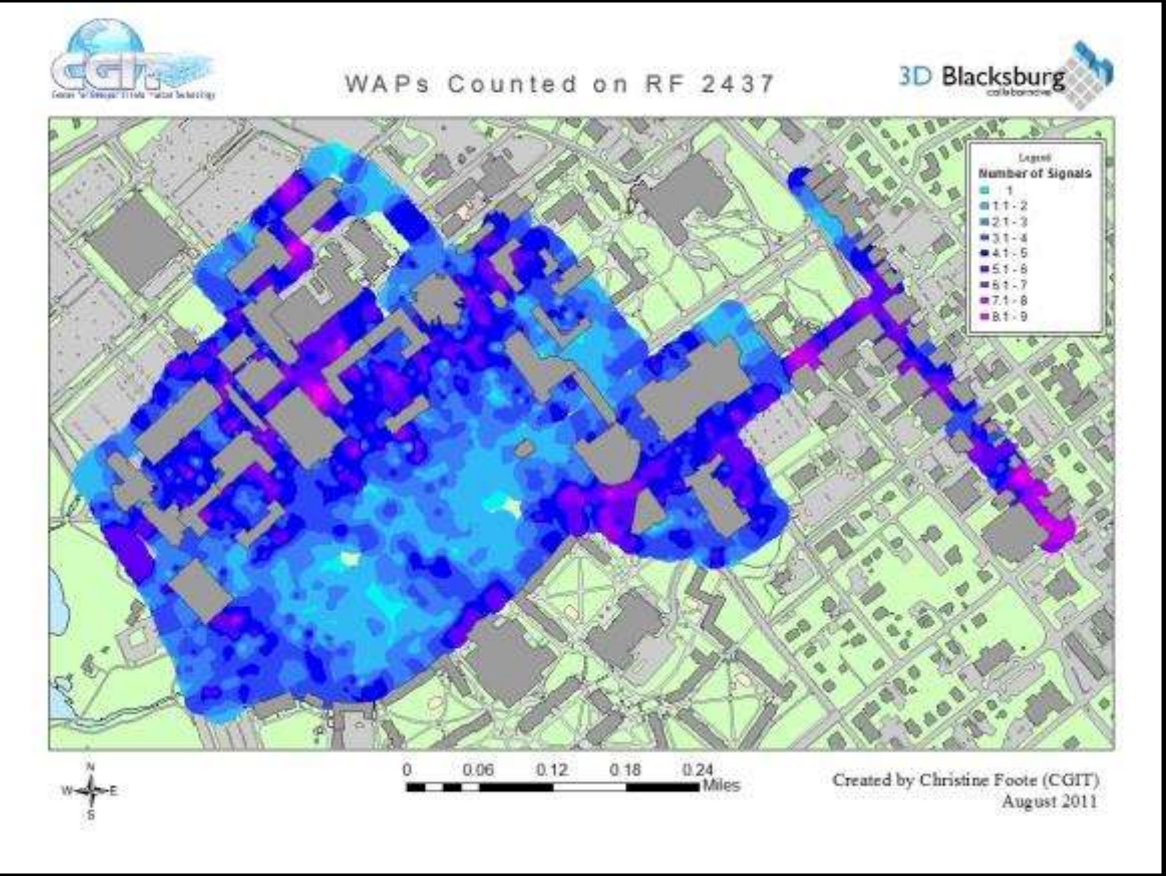
RF: 2412

The area behind Pamplin and Robeson Halls saw consistent large numbers of signals on this channel. This is also true of the areas surrounding Holden and Norris Halls, as well as the Squires Plaza.



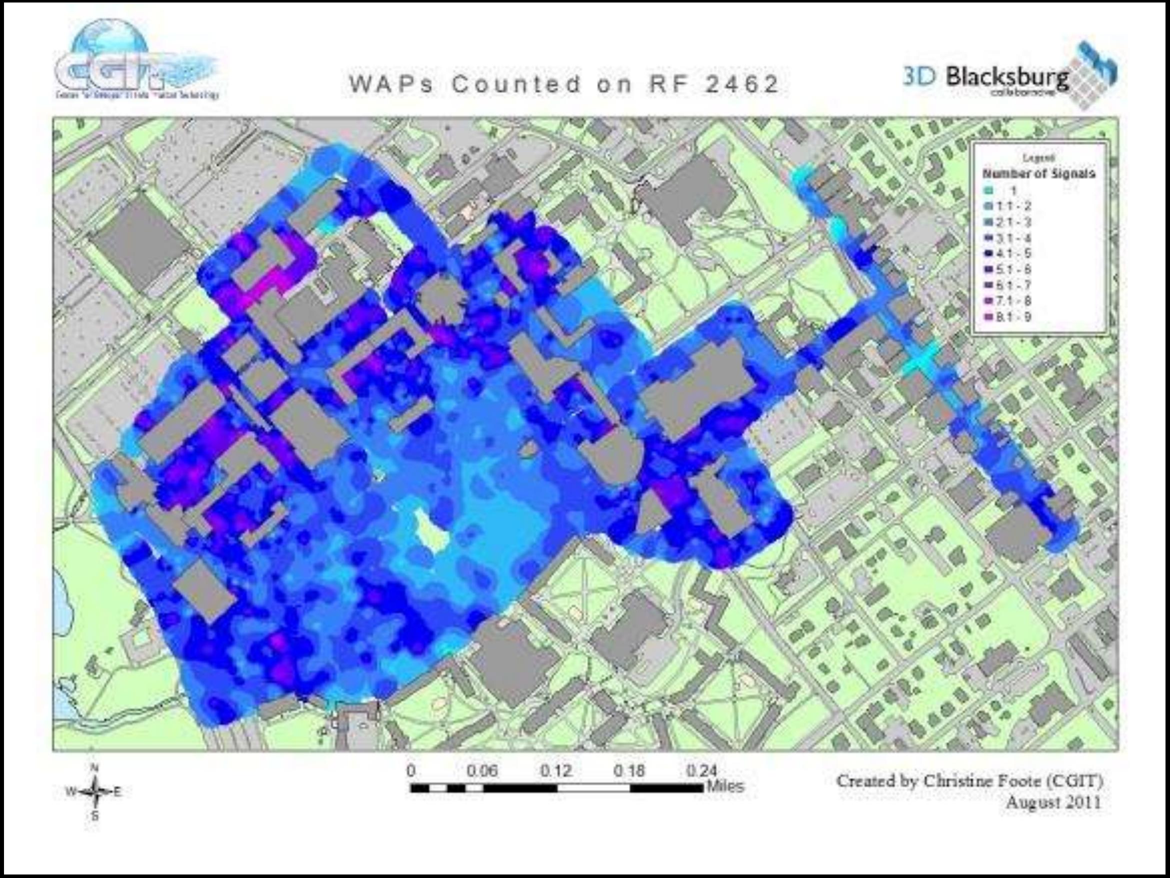
RF: 2437

There are some gaps in the Drillfield where no signals were observed from any network on this channel.



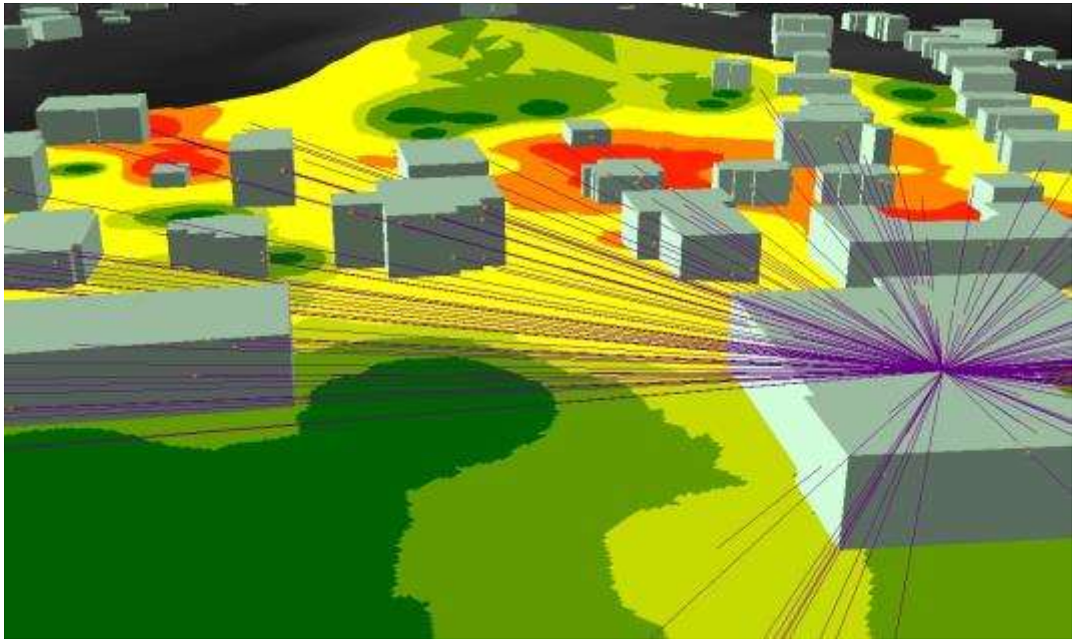
RF: 2462

There is a large gap in the center of the Drillfield where no signals were detected broadcasting on this channel. Consistently the most signals were seen surrounding Wittemore Hall.

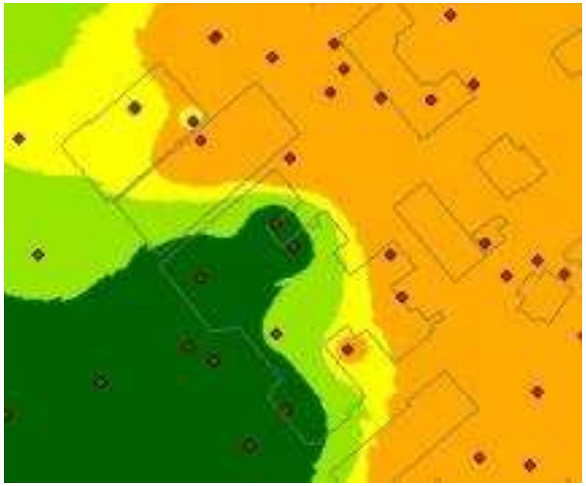


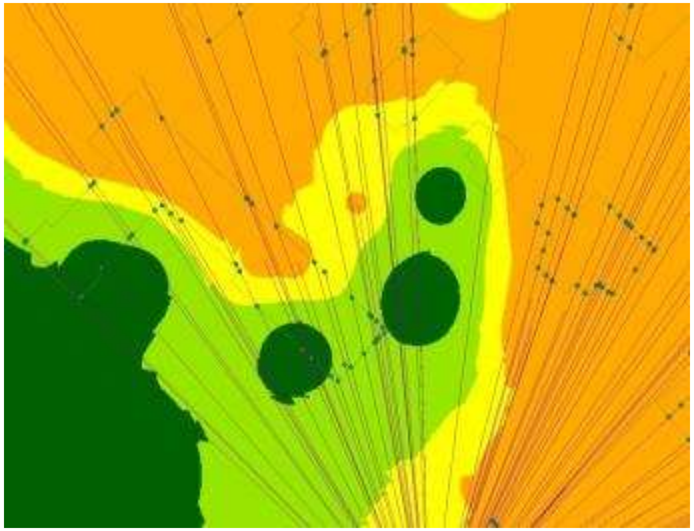
Motivation

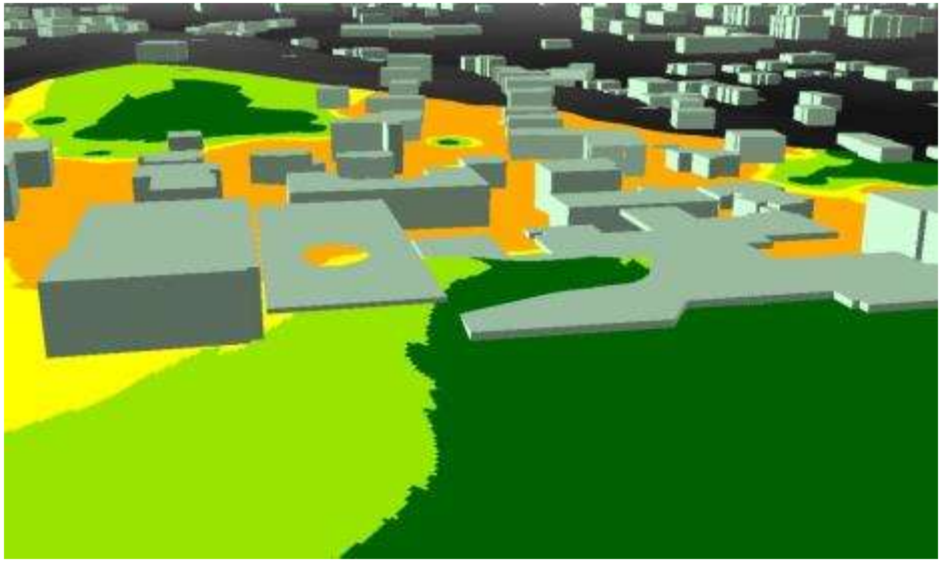
- Wireless Planning
- Optimization
- Movement toward Smaller Cells
- Public Health and Safety

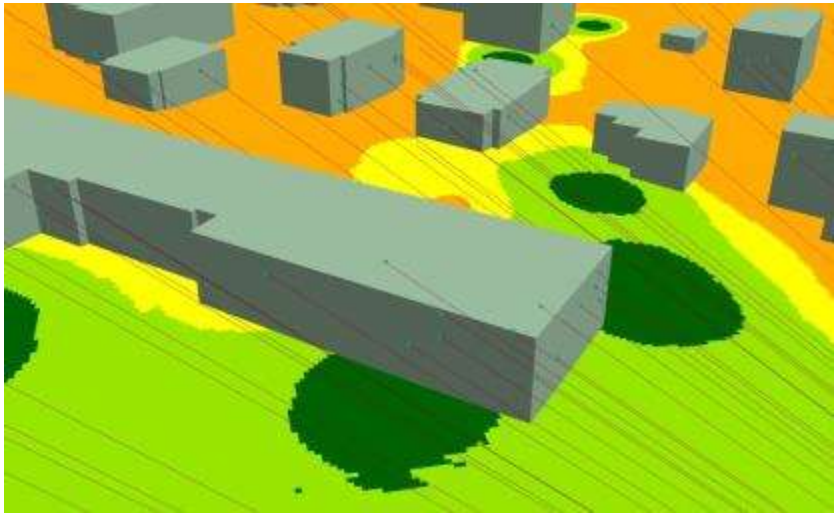


Urban Scale RF Model









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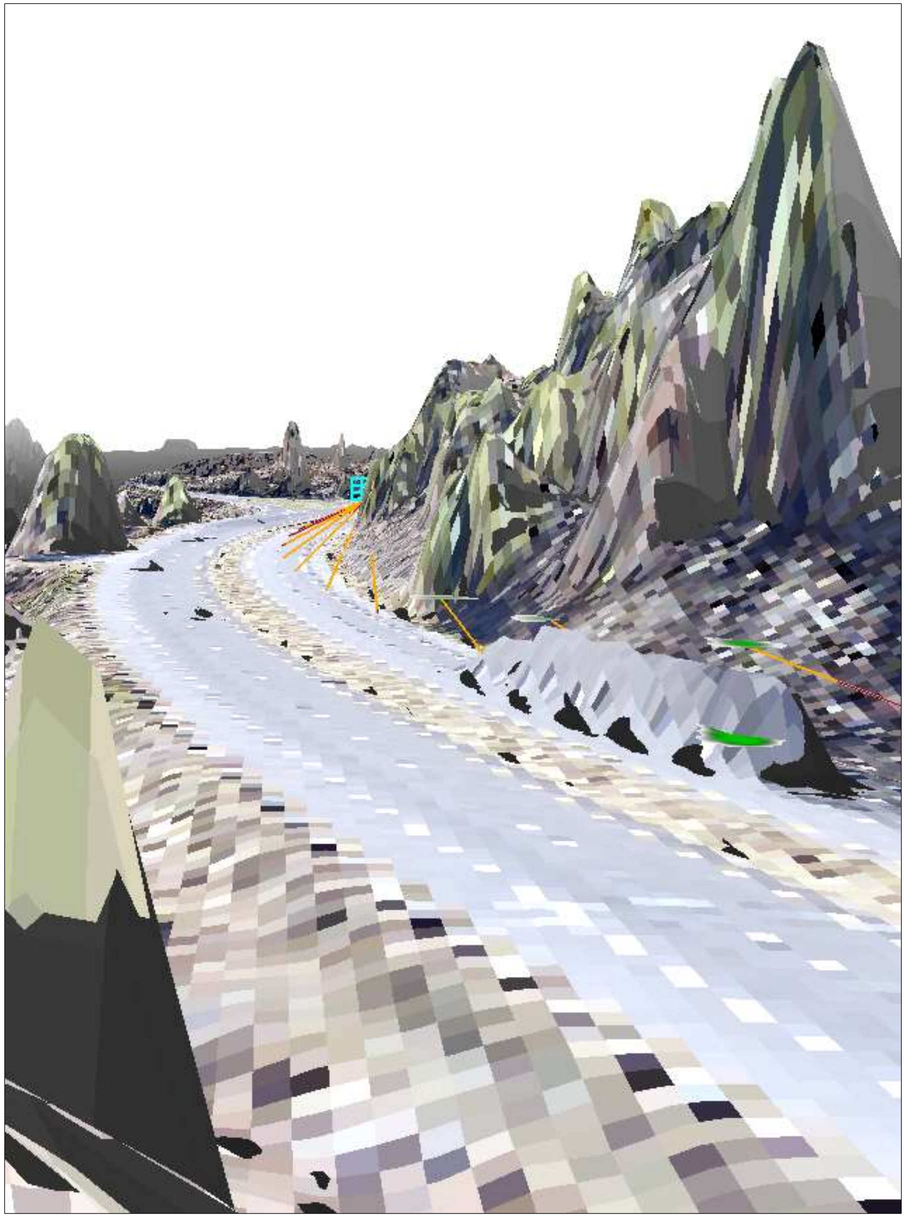
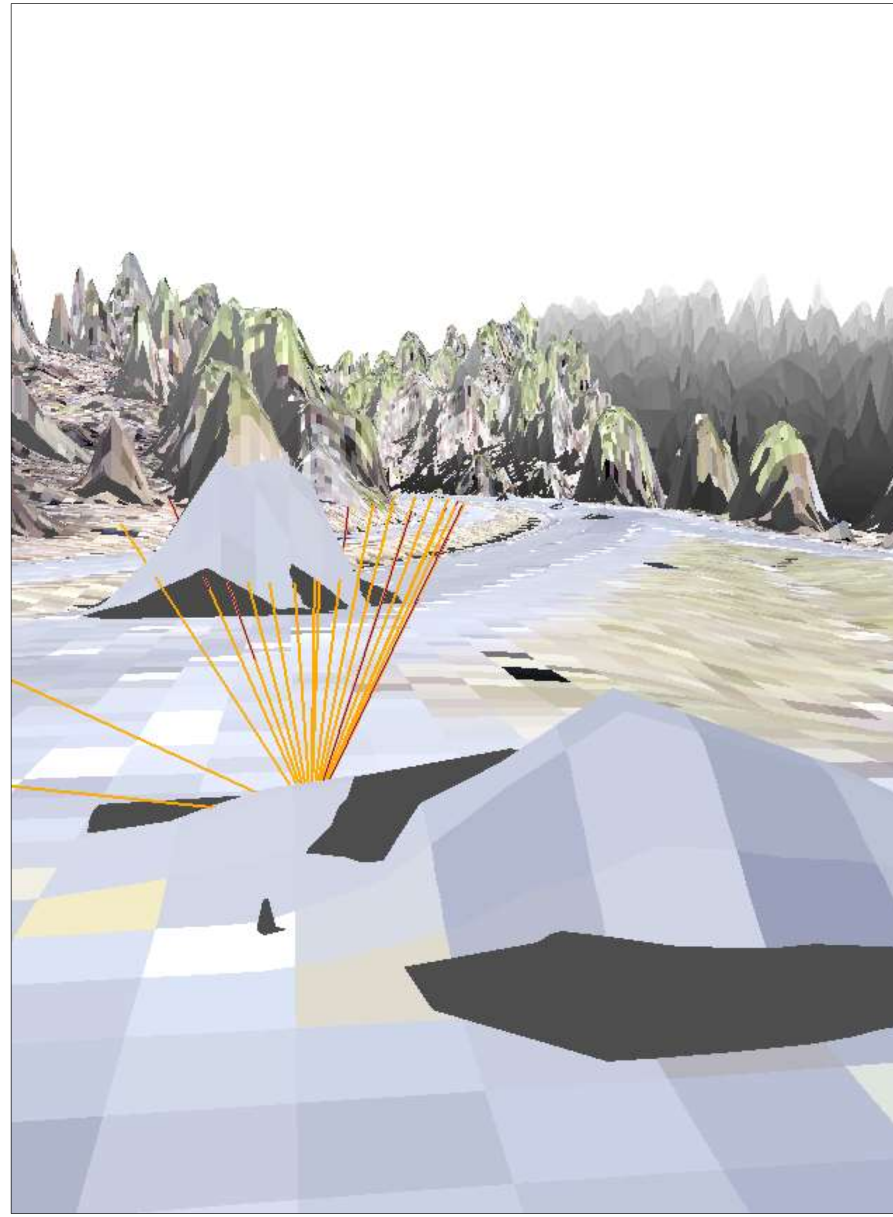



GRAPE & WINE QUALITY
EASTERN U.S. INITIATIVE

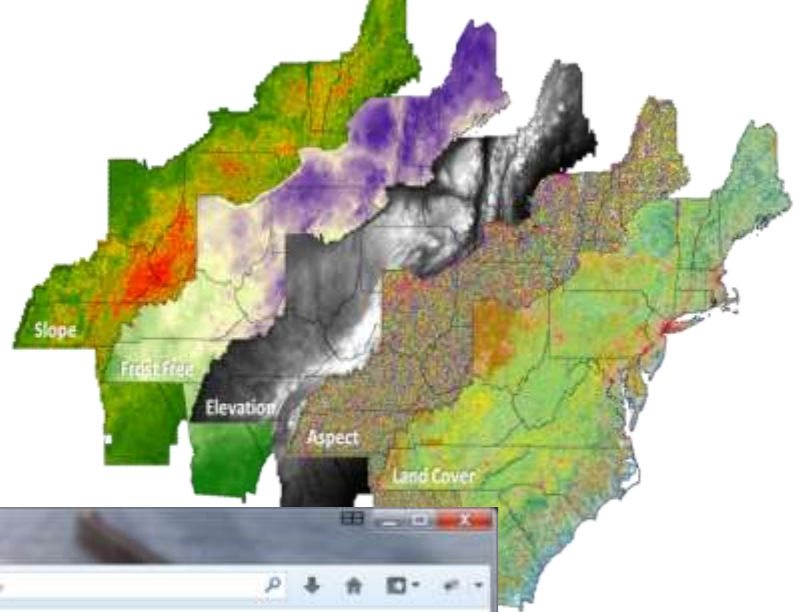
Eastern U.S. Web-based GIS Tool for Vineyard Site Evaluation

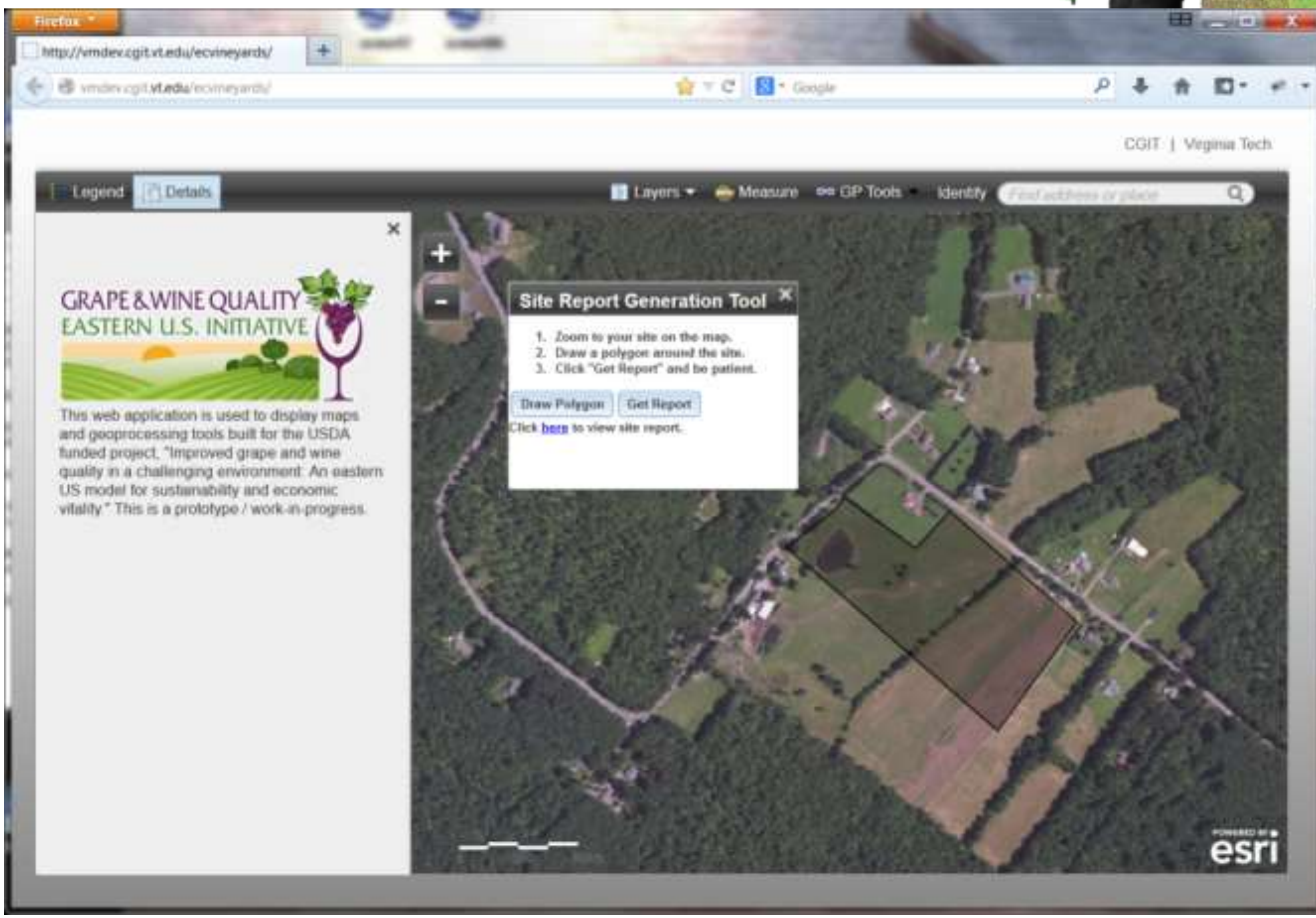
Virginia Tech Center for Geospatial Information Technology

2010-2015. USDA SCRI project (PI: Dr. Tony Wolf, Prof of Viticulture and Director of AHS AREC) “Improved Grape and Wine Quality in a Challenging Environment: An Eastern US Model for Sustainability and Economic Vitality”. The project spans 19 states in the Eastern US with both variety trials (NE1020), economic and Geospatial objectives for matching site x variety.

Site Assessment example:

http://www.cgit.vt.edu/vineyards/





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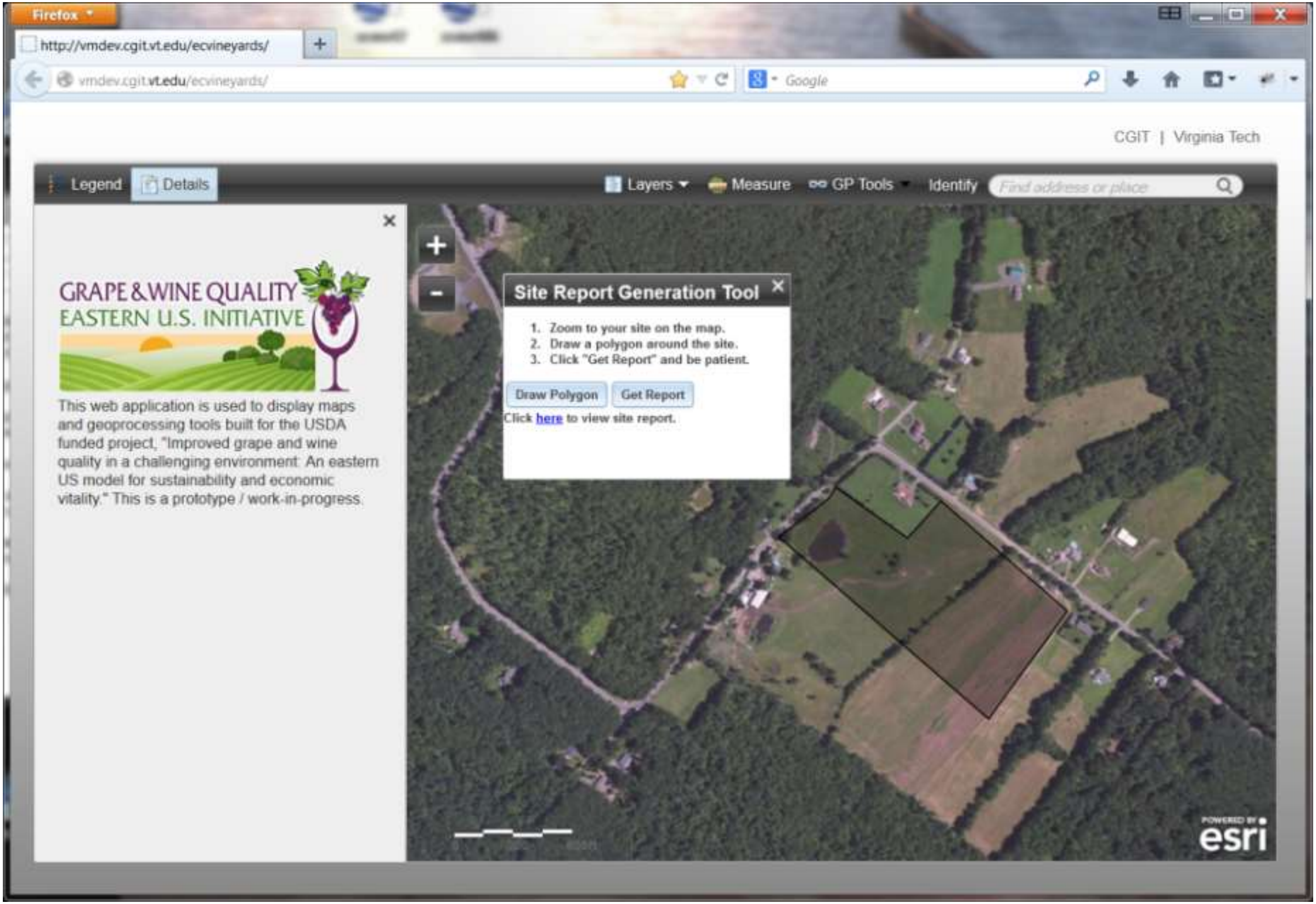

Vineyard Evaluation Report

Basemap Source: ESRI World Imagery

Your Site Description:

Size in Acres: ~20.6 acres

Geographic Location (latitude, longitude):
38.8355, -78.1163

Description of Site:
Sample Site Comment

Overview of Site Conditions

Soils

For further information see the in depth discussion of these parameters on the following pages.

Parameter	Average	Minimum	Maximum
Saturated Hydraulic Conductivity (KSat) (inches/hour)	1.68	0.32	3.34
Bulk Density (g/cm3)	1.38	1.3	1.46
Soil pH	5.18	5.0	5.29
Soil Organic Matter	0.55	0.54	0.96
Soil Depth (cm)	200.0	200.0	200.0
Available Water Capacity (AWC) (in./in. soil 30" profile)	0.13	0.13	0.16

Climate

These precipitation climate conditions are averages based on 30 years of data analyzed by the PRISM Group at Oregon State University. The other climate factors use PRISM layers as a base for calculations completed at Virginia Tech's Center for Geospatial Information Technology

Parameter	Value
Average Growing Season Temperature (Celsius)	18.44
Average Length of Growing Season (frost-free days)	177
Annual Precipitation (inches)	44.58
Growing Season Precipitation (inches)	28.3
Average Growing Season Degree Days (C)	1843.96
Spring Frost Index	April: 12.0 May: 12.6

Topography

These topographic conditions are determined using the best available public data. Use the in-depth discussion provided on the following pages to further understand how these conditions can effect vineyard production in your area.

Parameter	Average	Minimum	Maximum
Slope (percent slope)	4.05	0.02	14.22
Elevation (feet)	800	768	823

Solar Aspect:
North (16.3%), NE (25.9%), East (9.0%), SE (21.7%), South (15.7%), SW (8.1%), West (1.4%), NW (1.8%)

Topographic Features

Elevation in feet

Maximum	823
Average	800
Minimum	768

Elevation has a profound influence on the minimum and maximum temperatures in a vineyard, particularly in hilly and mountainous terrain. Because frosts and freezing temperatures can so dramatically reduce vineyard profitability, elevation is one of the most - perhaps the most - important features of vineyard site suitability. The physics of topographic effects on air temperature are well documented (Geiger, 1966) and its horticultural significance generally well appreciated.

Slope

The change in elevation over a horizontal ground distance, is expressed here as a percent. Gentle to moderate slopes are best-suited for vineyard production as they protect against damaging frosts (Wolf & Boyer, 2009). Cold air has a higher density than surrounding air, causing it to sink with gravity and move downhill. As a result, vineyards planted on slopes at higher elevations benefit from fluid cold air drainage away from vines and the resulting warm air displacement upwards.

0% - 2%	Poorly Suited
2% - 5%	Fairly Well-Suited
5% - 15%	Well-suited
> 15%	Poorly Suited

Minimum	0.02	%
Average	4.05	%
Maximum	14.22	%

Aspect

Aspect describes the direction a slope faces, which relates to the sun angle and amount of sunlight that reaches the ground. According to Dr. Tony Wolf, Virginia's State Viticultural specialist (p.16), aspect is one of the least influential factors related to a vineyard's overall suitability; however, choosing a site with a favorable aspect can enhance grape taste and facilitate efficient disease and pest management.

Northern 315° to 45°	North-facing	16.3%
	Northeastern-facing	25.9%
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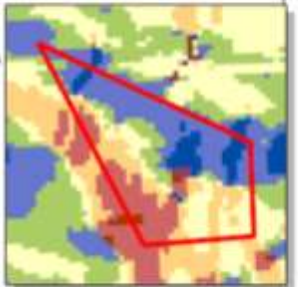
	Southwest-facing	8.1%
Western 225° - 315°	West-facing	1.4%
	Northwest-facing	1.8%



Land Cover

The Multi-Resolution Land Characteristics Consortium National Landcover Database (NLCD 2006) is a land cover classification that was generated using Landsat imagery.

Open Water	Barren Land	Grassland/Herbaceous
Open Space	Deciduous Forest	Pasture/Hay
Developed-Low Density	Evergreen Forest	Cultivated Crops
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Soils

Information

"Soil affects grapevine productivity and wine quality. Confounding influences of vineyard management, climate, varieties and clones, fertilizer and irrigation practices, as well as variation in fruit harvest and winery practices, may easily obscure the more subtle, unique soil contributions to wine quality. Soils cannot be evaluated independently of the other vineyard site considerations, and some compromises in soil quality may be necessary so that the vineyard site selection process does not become too exclusive." - Wolf and Boyer, 2009

Soil Conditions

Organic Matter Avg: 0.55 Min: 0.54 Max: 0.96

Organic matter is generated by the decomposition of plant and animal waste by the communities of soil arthropods and microbial decomposers that it supports. Organic matter improves soil fertility, structure, aeration and drainage. In large quantities, organic matter releases excess Nitrogen that can lead to vigorous vine growth.

Suitability Info: **Unsuitable:** < 1% or > 3% **Suitable:** 1% - 3%

Soil Depth (cm) Avg: 200.0 Min: 200.0 Max: 200.0

Deep soil depth acts as a protective buffer against drought as it allows for greater volume of potential soil moisture and ample space for cultivation of large, healthy, perennial root structures.

Suitability Info: **Unsuitable:** < 75 cm (30 in.) **Suitable:** > 75 cm (30 in.)

Available Water Capacity (AWC - in./in.)

Avg: 0.13 Min: 0.13 Max: 0.16

This describes the quantity of water available for uptake by plants after gravitational forces have removed excess water from a saturated soil. The ability of a soil to hold water is a function of soil texture and organic matter content.

Suitability Info: **Poorly Suited:** > .14in./in. **Fairly Suited:** .10 - .14in./in. **Well Suited:** < .1 in./in.

Saturated Hydraulic Conductivity (Ksat - in./hr)

Avg: 1.68 Min: 0.32 Max: 3.34

Ksat is a measure of the rate at which water moves through a column of saturated soil also described as permeability. Soils with Ksat values above 0.6 inches per hour tend to be better-suited for viticultural production.

Suitability Info: **Poorly Suited:** < 0.6 in./hr **Fairly Suited:** 0.6 - 2.0 in./hr **Well Suited:** >2.0 in./hr

Bulk Density (g/cm3)

Avg: 1.38 Min: 1.3 Max: 1.46

Bulk density describes the relationship between soil solids and pore space where air and water can be stored in a given volume of soil. Bulk density is a key factor in productive viticulture because bulk densities higher than 1.6 g/cm3 indicate compacted soil, restricted water movement, poor root development and loss of soil aeration.

Suitability Info: **Unsuitable:** > 1.6 g/cm3 **Suitable:** < 1.6 g/cm3

Soil pH Avg: 5.18 Min: 5.0 Max: 5.29

Soil pH is easily amended, but the cost of amendment whether through lime or gypsum applications may be cost prohibitive for some growers if pH is above 7.5 or below 4.0. Appropriate soil pH levels are critical to vine health. Low pH values are especially detrimental to grapevines as Aluminum and Copper are made plant available which can lead to stunted growth and toxicity.

Suitability Info: **Unsuitable:** ph < 4.0 or > 7.5 **Suitable:** ph = 4.0 - 7.5

Soil Series Details

- Dyke loam, eroded sloping phase
- Dyke loam, gently sloping phase
- Meadowville loam
- Worsham stony silt loam

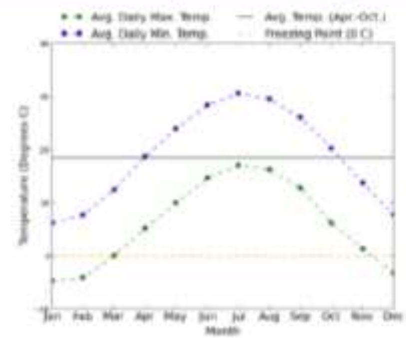
For more soils information: http://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/

Climate and Weather

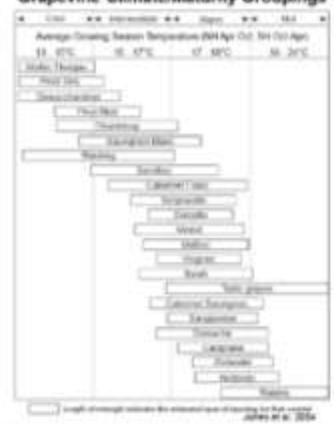
Information

Grapes can be exposed to environmental stresses that can reduce crop quality and yields and injure or kill grapevines. Damaging winter temperatures, spring and fall frosts, extremes of rainfall, and higher than optimal summer temperatures occur with regularity in some regions. Climate refers to the average course of the weather at a given location over a period of years and is measured by temperature, precipitation, wind speed and other meteorological conditions. "Weather" is the state of the atmosphere at a given moment with respect to those same meteorological conditions.
- Wolf and Boyer, 2009

Seasonal Temperature Analysis



Grapevine Climate/Maturity Groupings



Climate and Weather Conditions

Basic Climate Factors

- Average Growing Season Temperature (Mean Temperature April - October)
  °C: 18.44 °F: 50.44
- Average Growing Season Degree Days (C) (Avg. Daily Mean Temp. - Base Temp. 10°C)
  °C: 1843.96 °F: 3319.13
- Length of Growing Season - frost-free days 177
- Annual Precipitation in inches 44.58
- Growing Season Precipitation in inches 28.3
- Spring Frost Index in °F April: 12.0 May: 12.6 (Avg. Daily Mean Temp. - Avg. Daily Min Temp.)

Extreme Low Temperature Risk Factor

(Number of winters < threshold in a decade)

Threshold:	5°F	0°F	-5°F	-10°F	-15°F
Winters:	3.0	0.0	0.0	0.0	0.0

Other Information:

The length of the growing season will determine whether grapes will ripen or not. A minimum of 180 frost-free days is recommended.

Grapevines can be injured or killed by winter cold. See chart above for statistics on average number of winters with extreme cold temperatures.

Overview of Site Conditions

Soils

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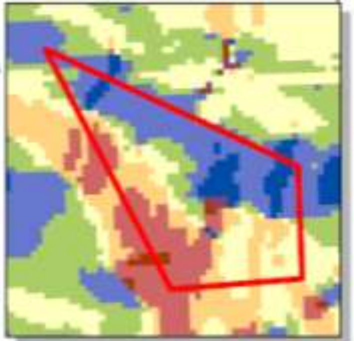

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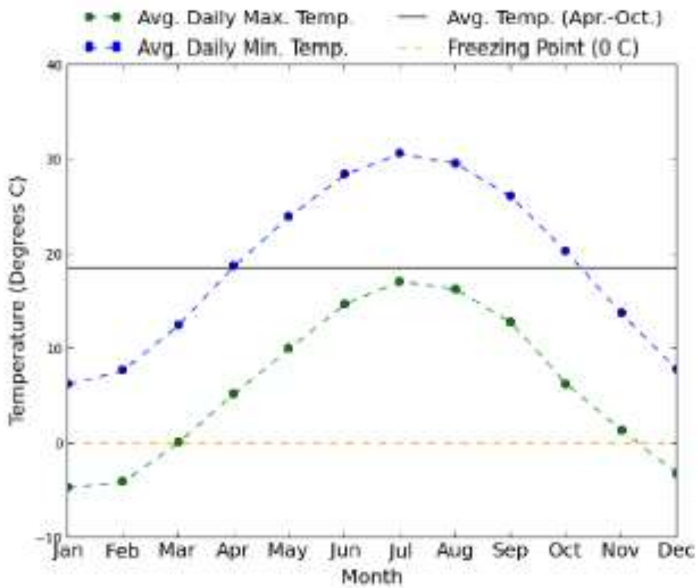

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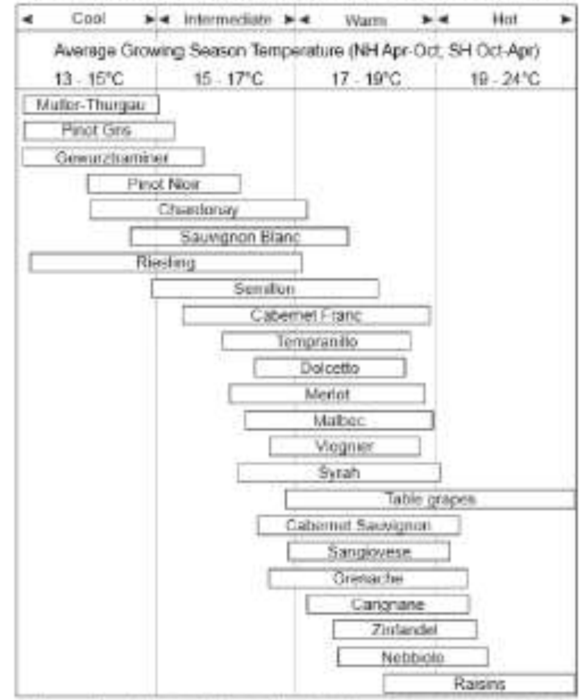

Jones et al. 2004

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