Analysis of solar radiation potential for business and residential use in Charleston, South Carolina.
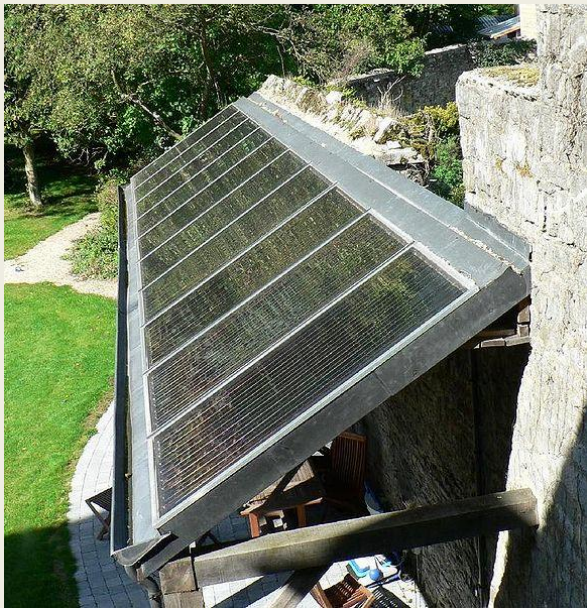
Joshua Tanner
MEA582
Fall 2012

Problem

- Total amount of solar radiation for a surface
- Differences between an urban and suburban environment
- Method to communicate results to the consumer

Image: NOAA

Reason for study

- LiDAR Data
- Alternative / Renewable Energy
- Web Application Development

Geographic Considerations

- Charleston, South Carolina
- Suburban Neighborhood
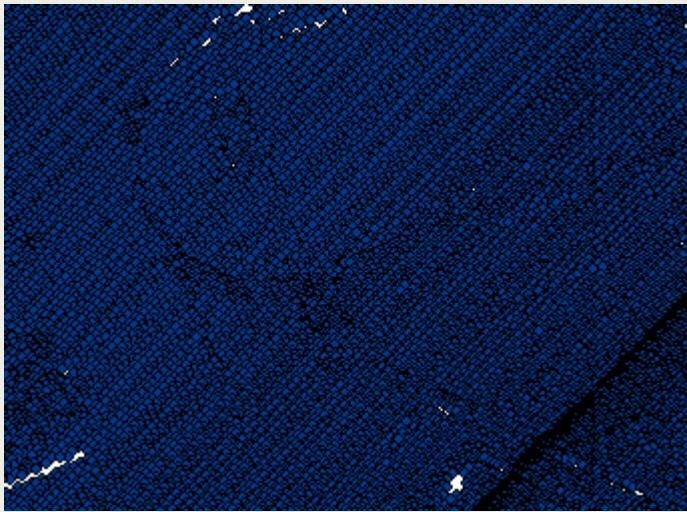- Medical University of South Carolina
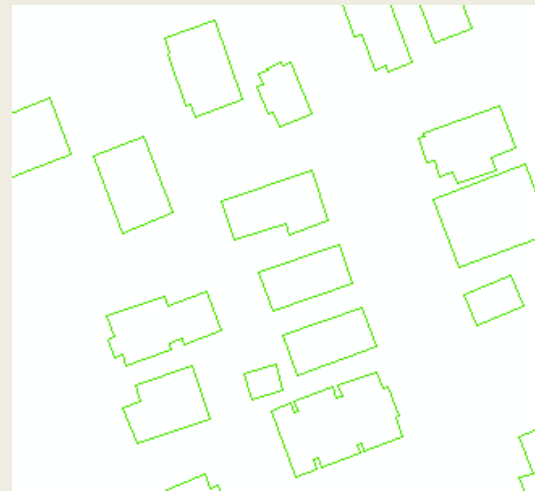

Suburban

Urban

Data

- LiDAR - NOAA Coastal Services Center
- Building Footprints - City of Charleston
- Neighborhood Boundaries - City of Charleston

LiDAR

Building Footprints

Methods Overview

- Analyzing LiDAR points for appropriate DEM cell size
- Creating a terrain from the LiDAR points
- Developing a DEM at the suitable resolution
- Performing solar radiation analysis
- Extracting solar surface using the buildings as a mask
- Calculating statistics on the rooftop radiation surface

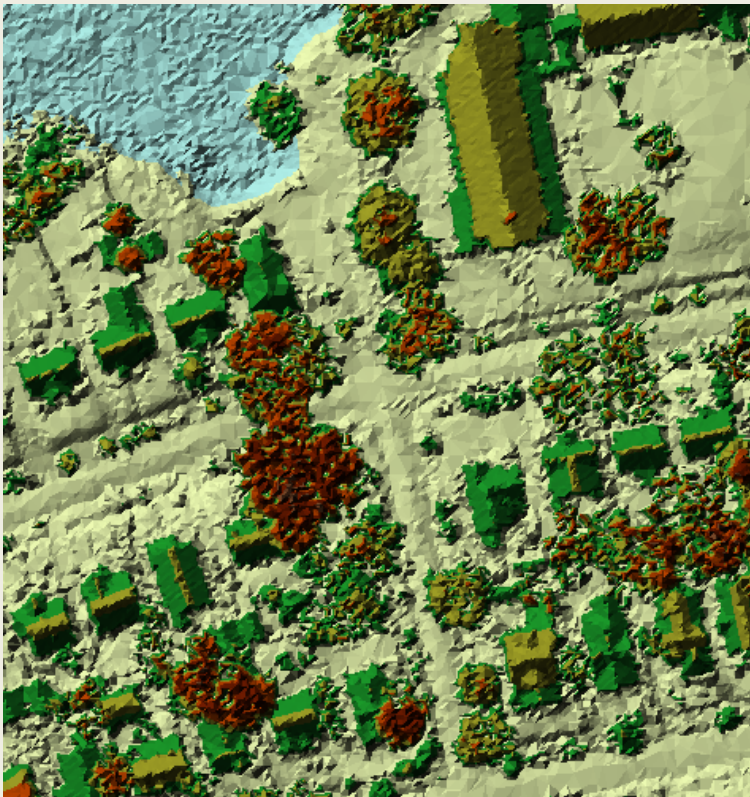Analyse & Create Raster Surface from LiDAR

Perform Solar Analysis
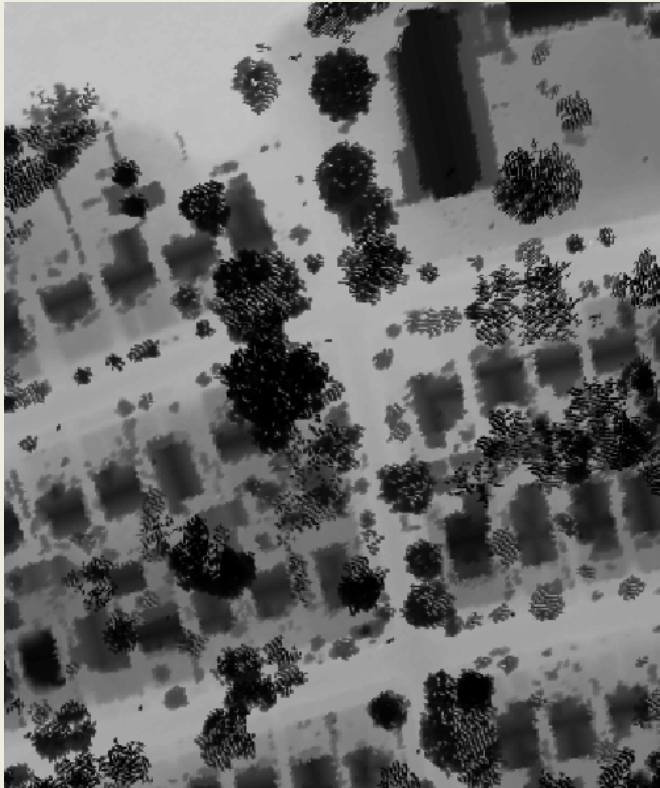
Calculate Statistics from Solar Surface

Method Details

1. Determining appropriate cell size

2. Creating a terrain from the LiDAR points
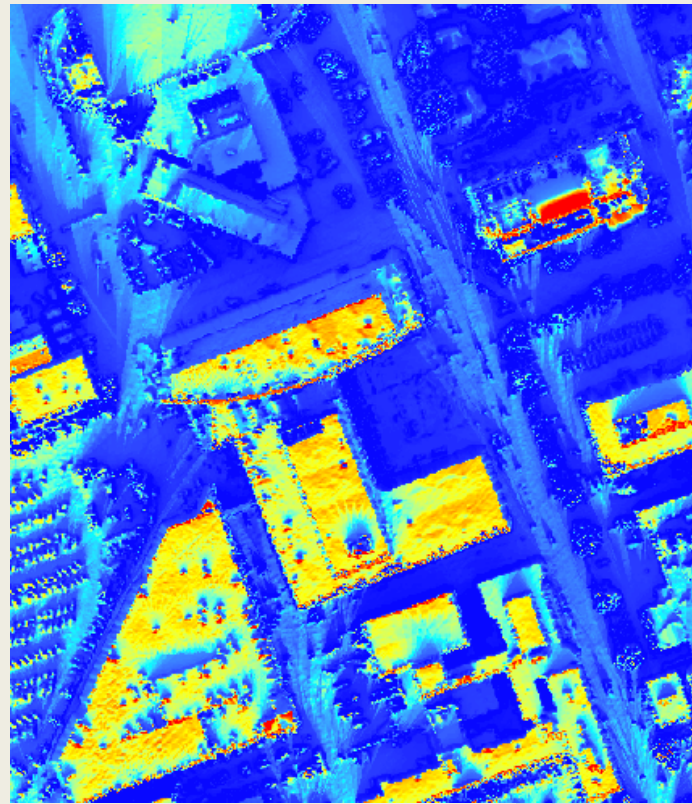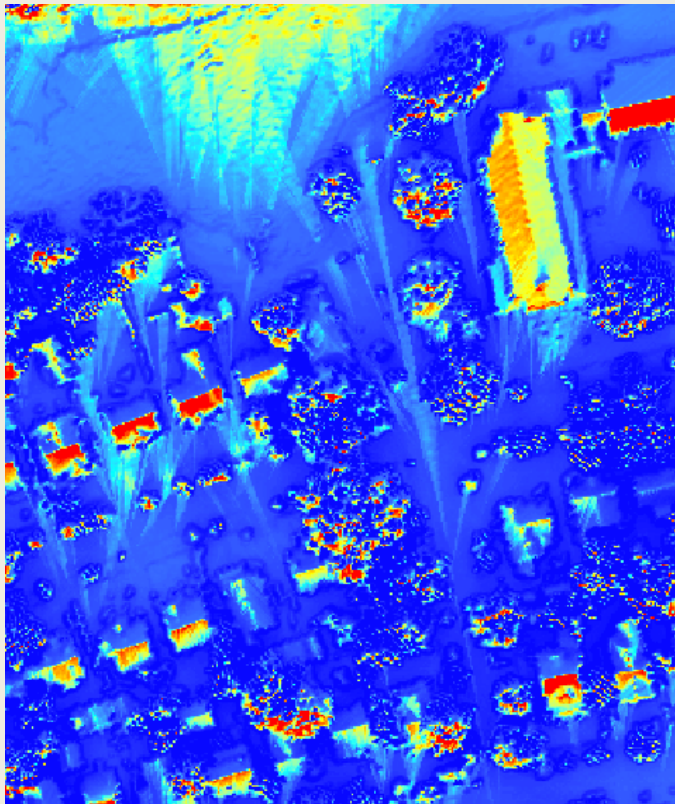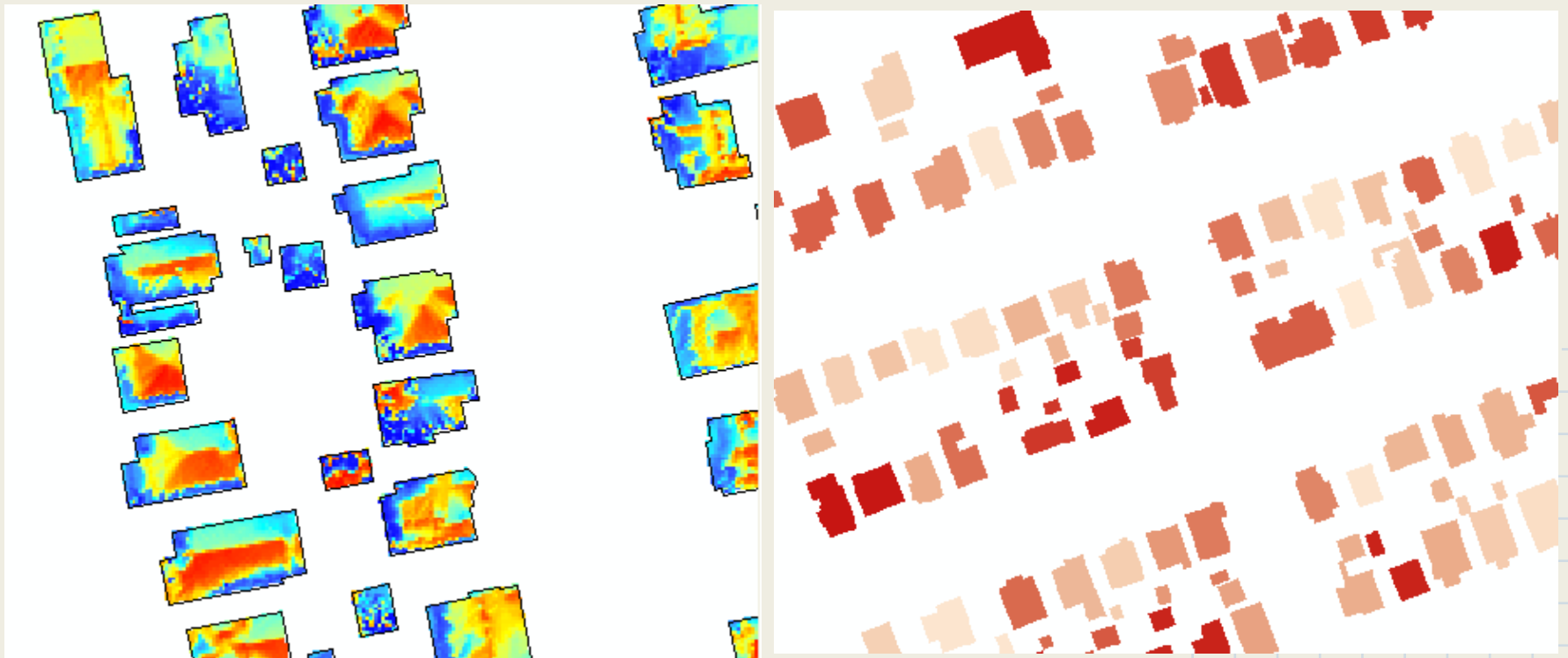
Method Details

3. Develop DEM

Method Details

4. Perform solar radiation analysis
(Watt Hours per Square Meter)

Method Details

5. Extract by mask
6. Calculate zonal statistics


Mean Solar Radiation for Rooftops

Results

	Mean	Maximum	Minimum	Standard Deviation
Wagener Terrace	429.59+-204.55	1722.72+-477.78	3.86+-20.09	415.76+-185.54
MUSC	631.51+-204.42	2116.01+-422.46	0.21+-2.35	493.38+-134.11

Values in Watt Hours per Square Meter for Winter Solstice

* Urban Setting - Greater average and maximum solar radiation but also had a minimum statistic of almost zero
* Suburban Setting - Lesser average and maximum solar radiation, but greater minimum value

Results - Mean

Urban - Tall, flat, equipotential surfaces receive sunlight throughout the day.
Can be limited by surrounding buidings.
Suburban - Limited by rooftop slopes and canopy cover.
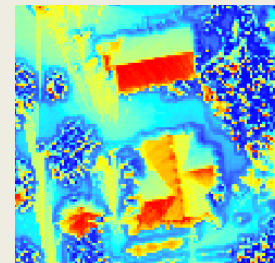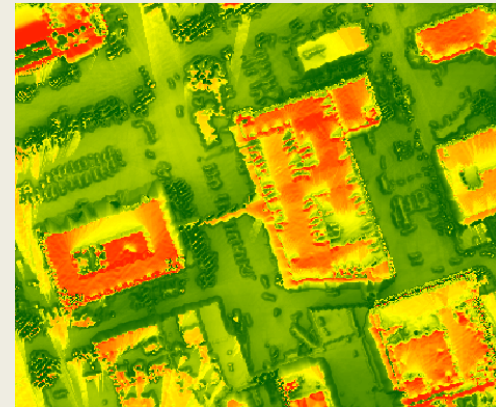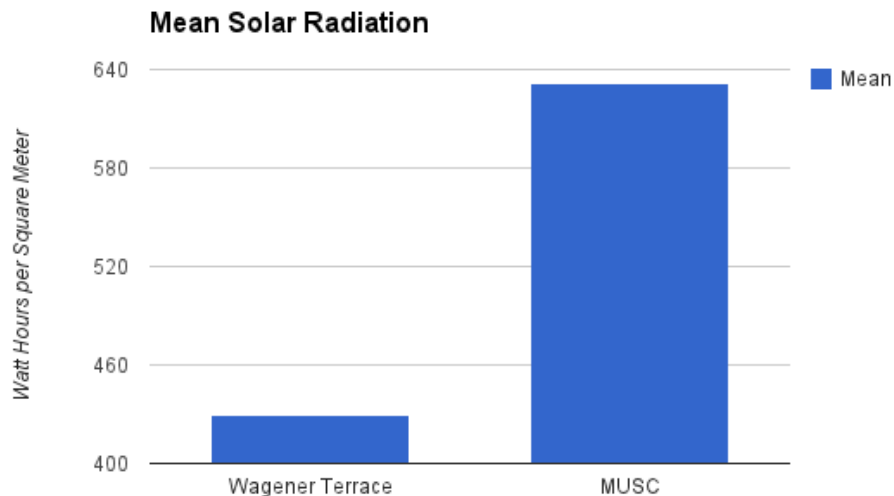
Results - Max/Min

Maximum - Taller buildings in urban areas are mostly unobstructed and gain sunlight throughout all of peak light hours.
Minimum - Some taller buildings can completely block sunlight from nearby buildings
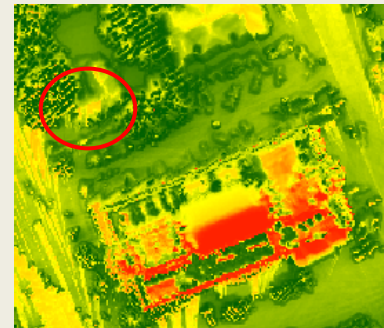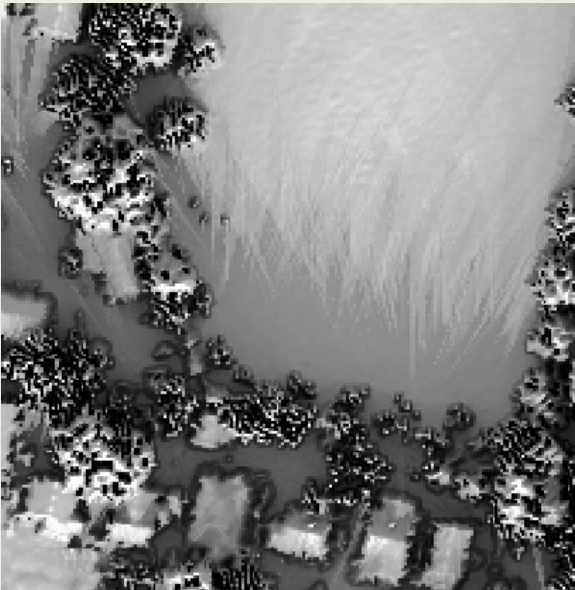
What's Next

- Solar Analysis for Summer Solstice
- Simple Web Mapping Application to Identify Rooftop Radiation Values

Conclusion

- Most Important Findings
    - LiDAR -> Solar Radiation Surface
    - Characteristics Impacting Radiation Values