



Project Goals:

- Determine a suitable study area by availability of LiDAR.
- Use a LiDAR generated DEM for Solar Analysis.
- Use the Oregon Department of Transportation's (ODOT) Solar Project methodologies as a guide to develop a model for use in our study area.
- Use the model to determine areas with high solar potential using the Solar Radiation Tools in ArcGIS.



China is currently seen as a leader in the development and use of solar energy. The Chinese government heavily subsidizes green energy.

The average US Home consumed 10,650 kW/Year in 2009.

<http://topics.nytimes.com/top/news/business/energy-environment/solar-energy/index.html>
<http://www.chinahighlights.com/image/map/province/china.jpg>

United States Department of Energy



- Rooftop Solar Challenge
 - \$12 Million
- Recent investment to bolster technology to concentrate solar energy
 - \$60 million

<http://energy.gov/science-innovation/energy-sources/renewable-energy/solar>

<http://energy.gov/articles/doe-awards-12-million-spur-rapid-adoption-solar-energy-rooftop-solar-challenge>

[https://encrypted-tbn3.google.com/images?q=tbn:ANd9GcTqIVcHIVUx1ULpy4VsrGT6ZvBV_r3oSn5\\$V_a0oOp9UzCtReu](https://encrypted-tbn3.google.com/images?q=tbn:ANd9GcTqIVcHIVUx1ULpy4VsrGT6ZvBV_r3oSn5$V_a0oOp9UzCtReu)

ODOT Study

- In 2008, ODOT built the first solar highway project in the US.
 - Generates 130,000 kWh/year.
- ODOT's long term goal is to build enough renewable energy capacity to make all 47 M kwh required annually.
 - signals, illumination, buildings, ramp metering.



Slide from ODOT presentation

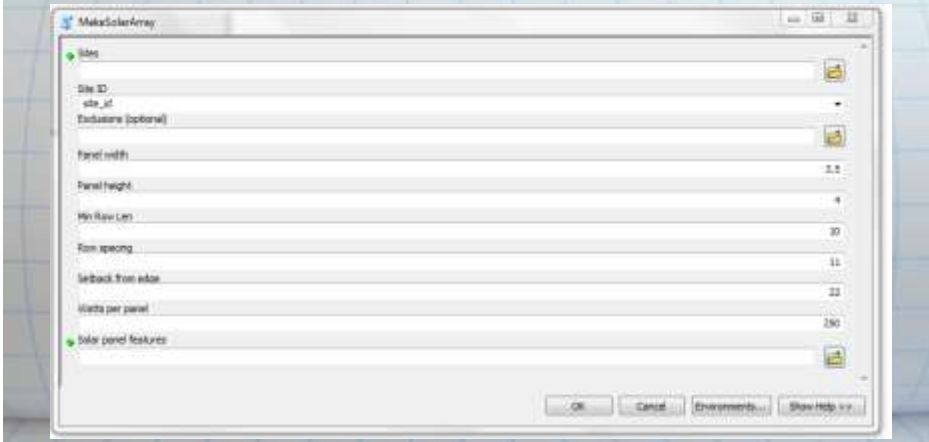
ODOT Study:

- Criteria Used from ODOT study:
 - Southern orientation
 - Slope of less than 15%
 - Identify which sites are in flood plains or that have known wetlands or protected stream corridors



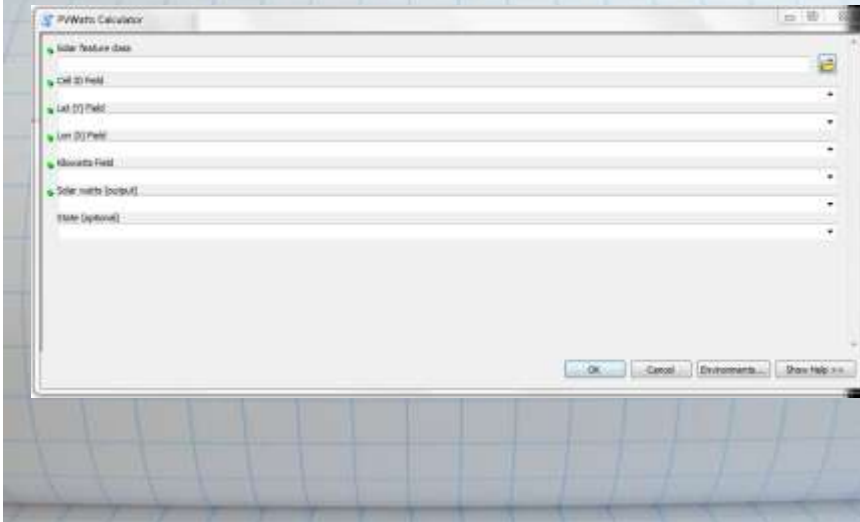
ODOT Processes

- ODOT didn't use ESRI's Solar Radiation tool.
- ODOT used National Renewable Energy Laboratory (NREL) tools.
 - Make Solar Array



ODOT Processes

PVWatts Grid Data Calculator



ODOT Processes:

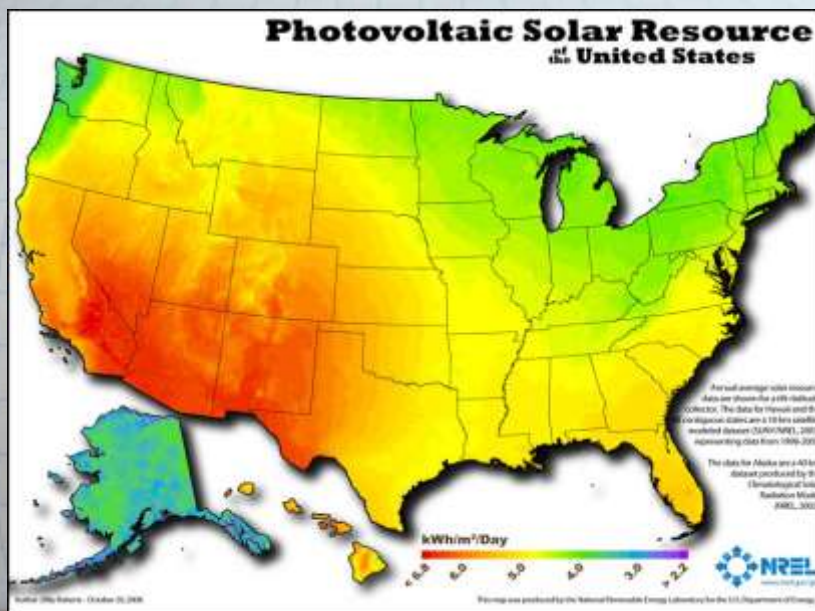
Online PVWatts Viewer:

http://mapserve3.nrel.gov/PVWatts_Viewer/index.html

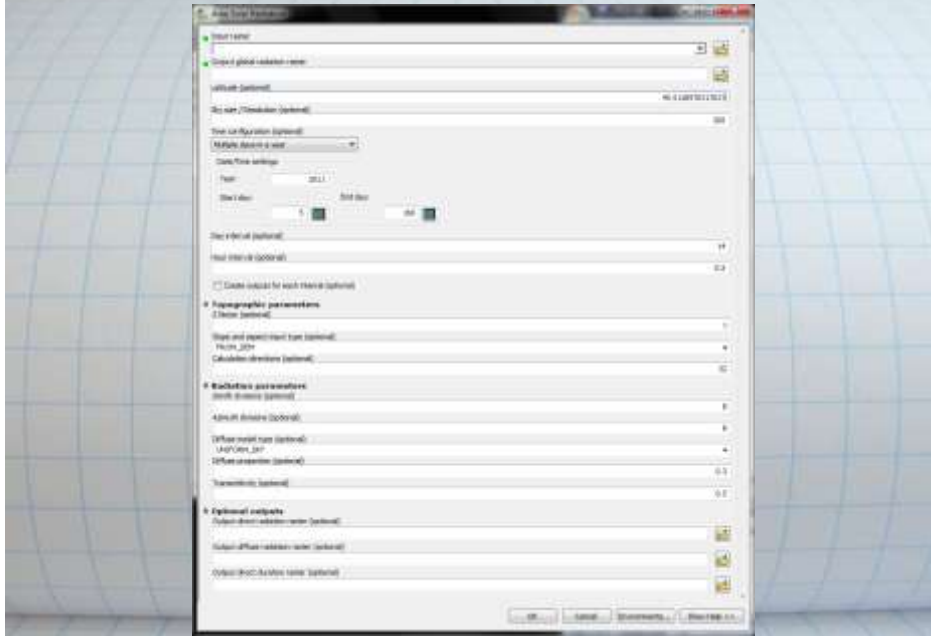


<http://www.nrel.gov/gis/>

NREL Solar Resource Fraction Map

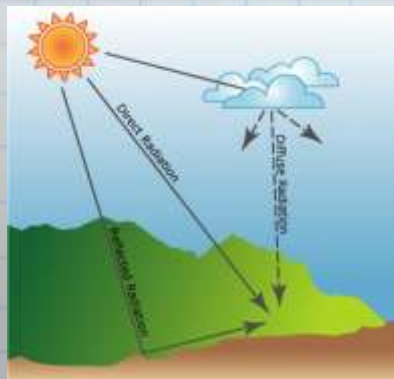


Solar Radiation Tool



Solar Radiation Tool

- The solar radiation tool in ArcGIS doesn't include reflected radiation.
- The total radiation is calculated as the sum of the direct and diffuse radiation.



http://webhelp.esri.com/arcgisDesktop/9.3/index.cfm?TopicName=Calculating_solar_radiation

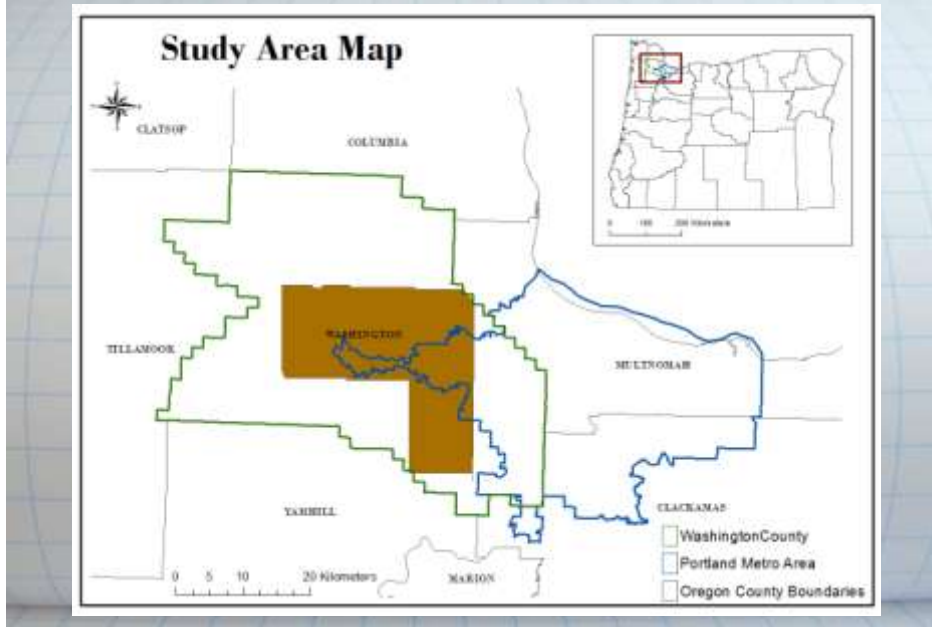
MODEL



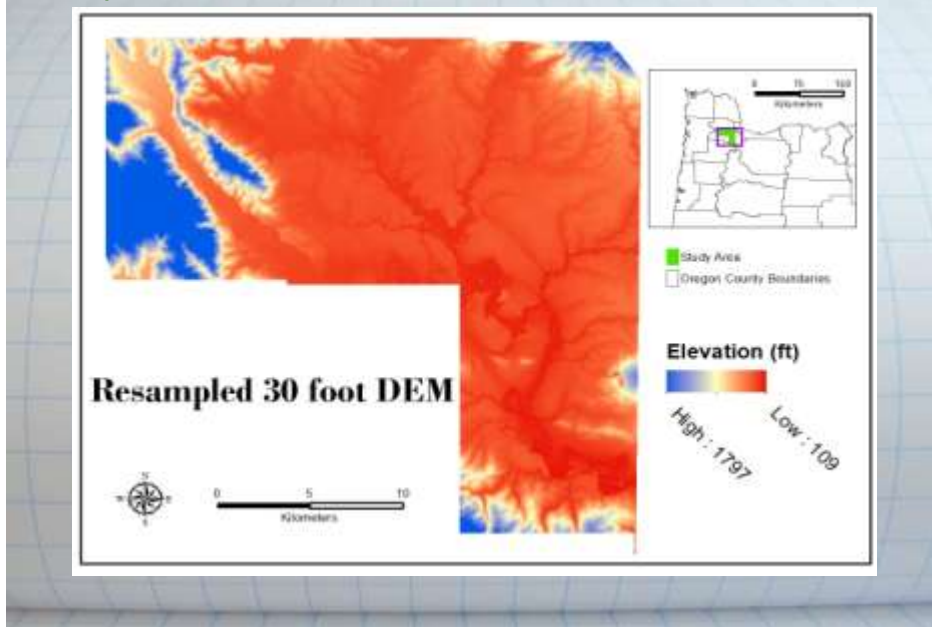
Exclusionary Criteria:

- Slope
- Aspect
- Floodplain
- Wetlands
- Total Solar Fraction

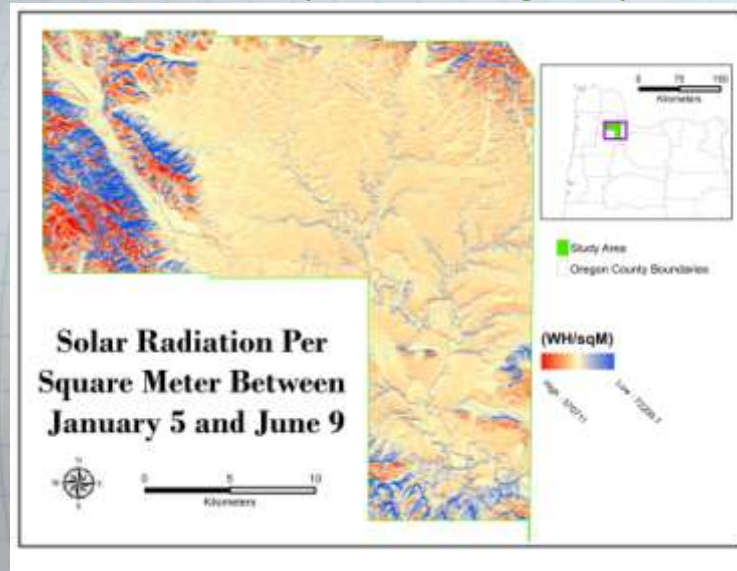
Study Area:



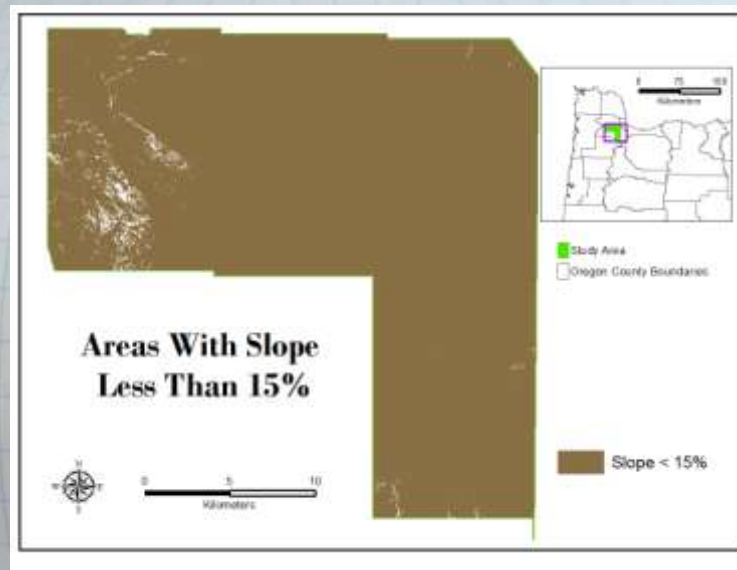
Study Area



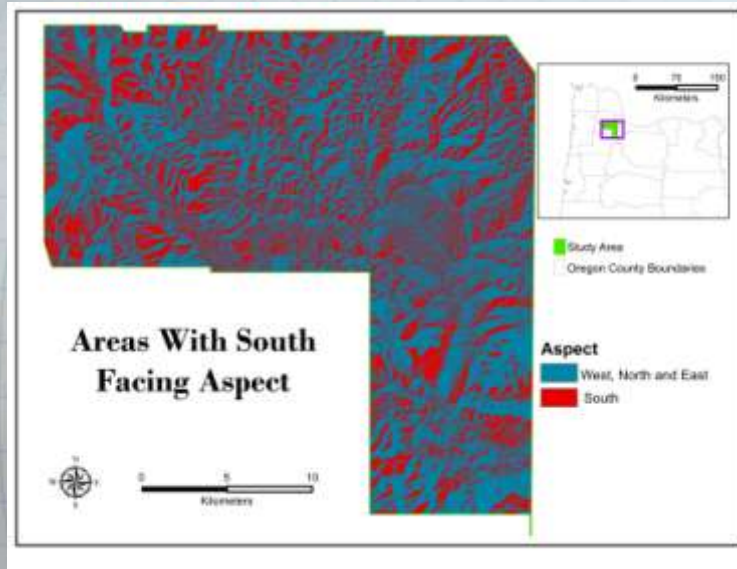
Solar Radiation in Study Area During Study Period



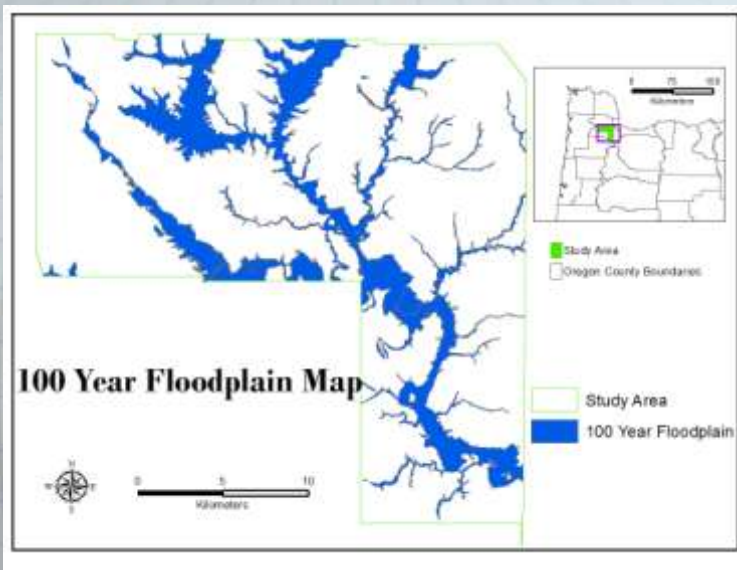
Slope



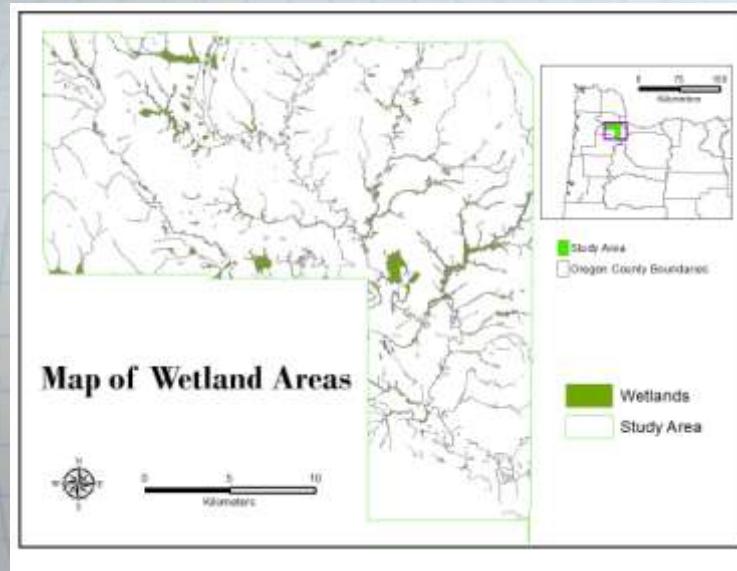
Aspect



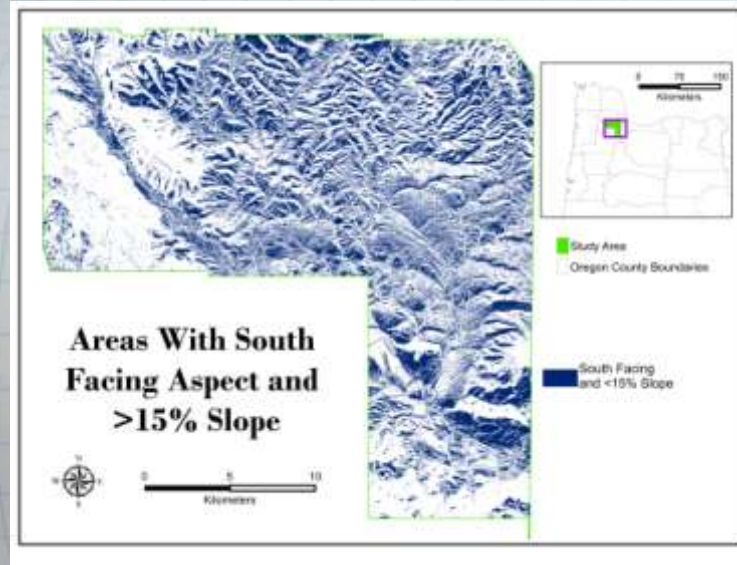
Floodplain



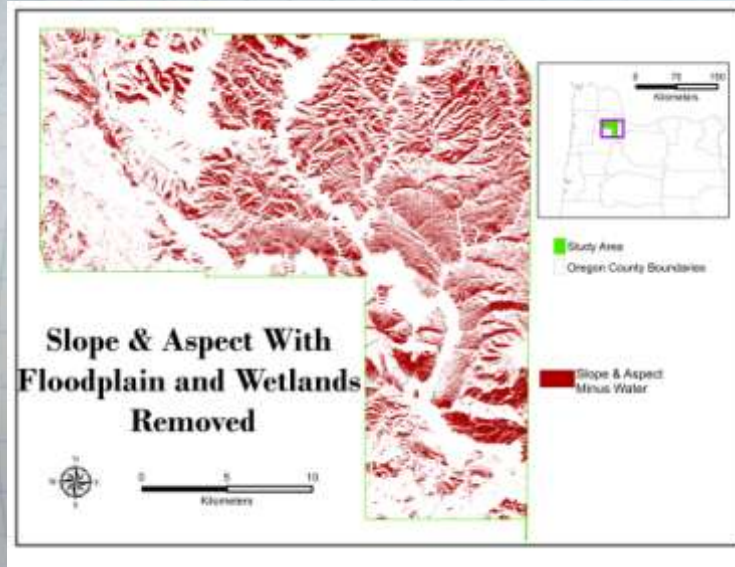
Wetlands



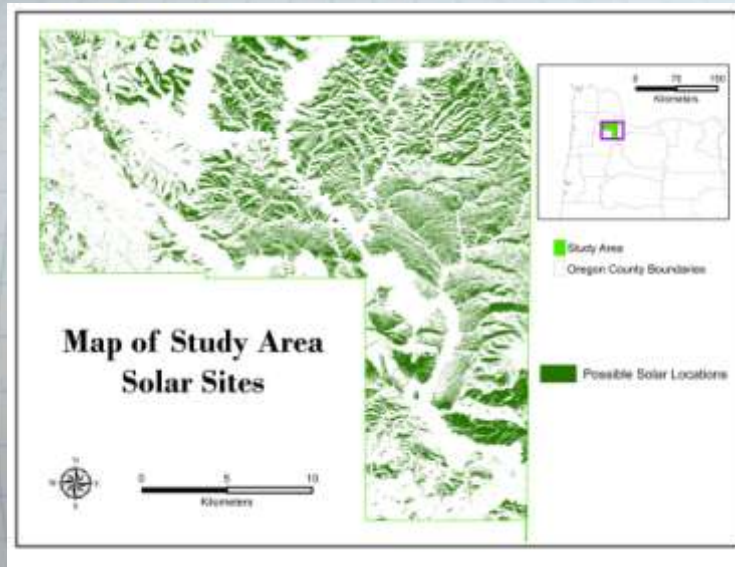
Slope / Aspect Intersect



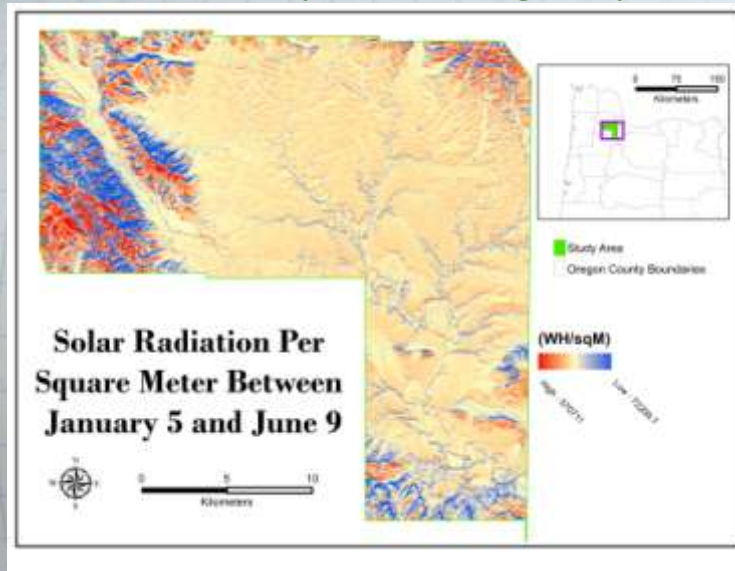
Slope / Aspect / Water Subtracted



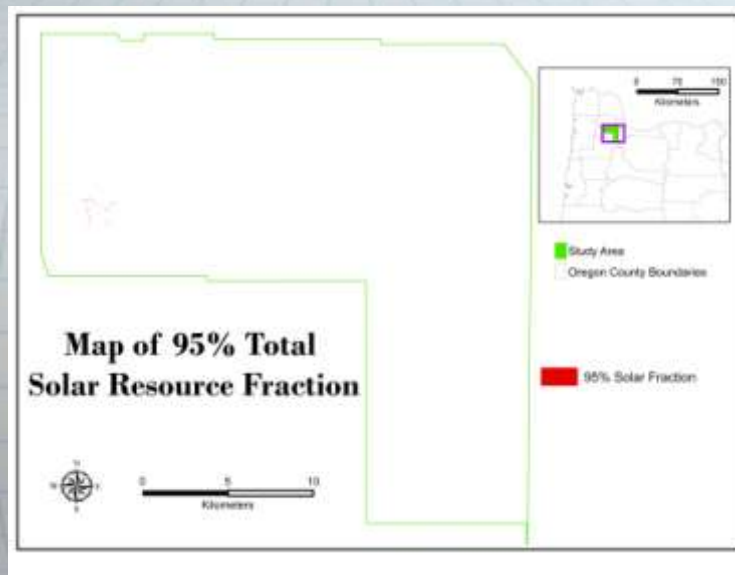
Study Area Solar Sites Over 3m²:



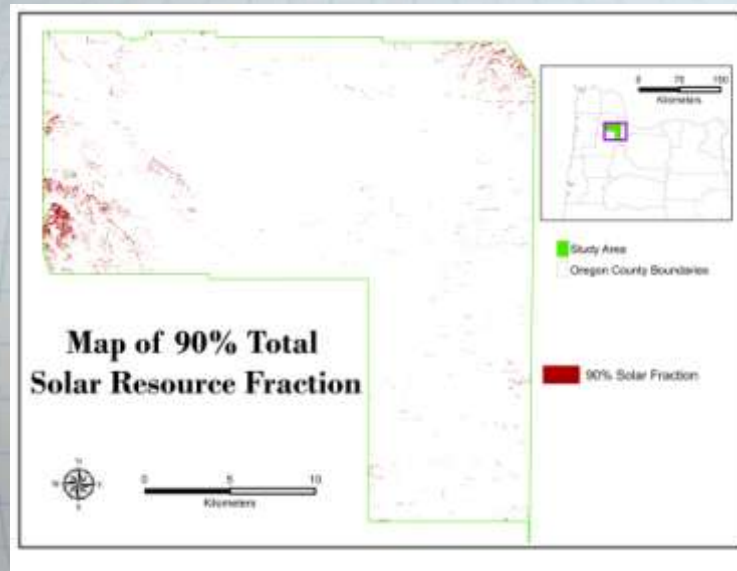
Solar Radiation in Study Area During Study Period



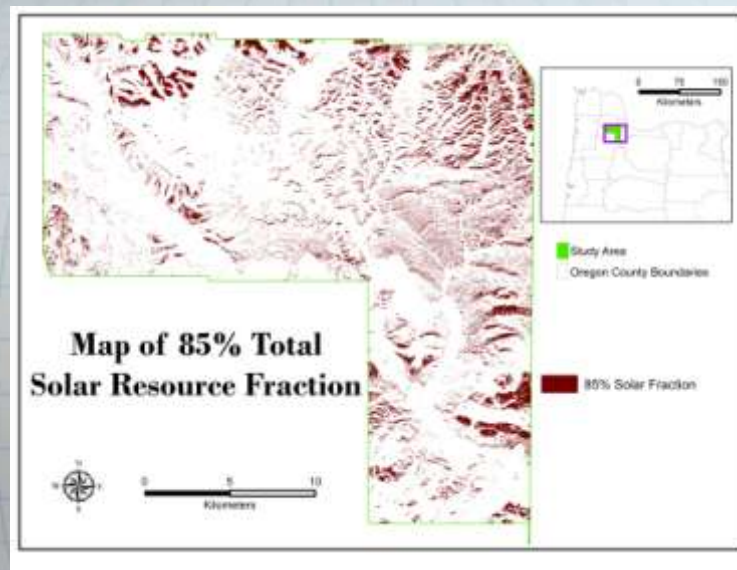
95% Map



90% Map

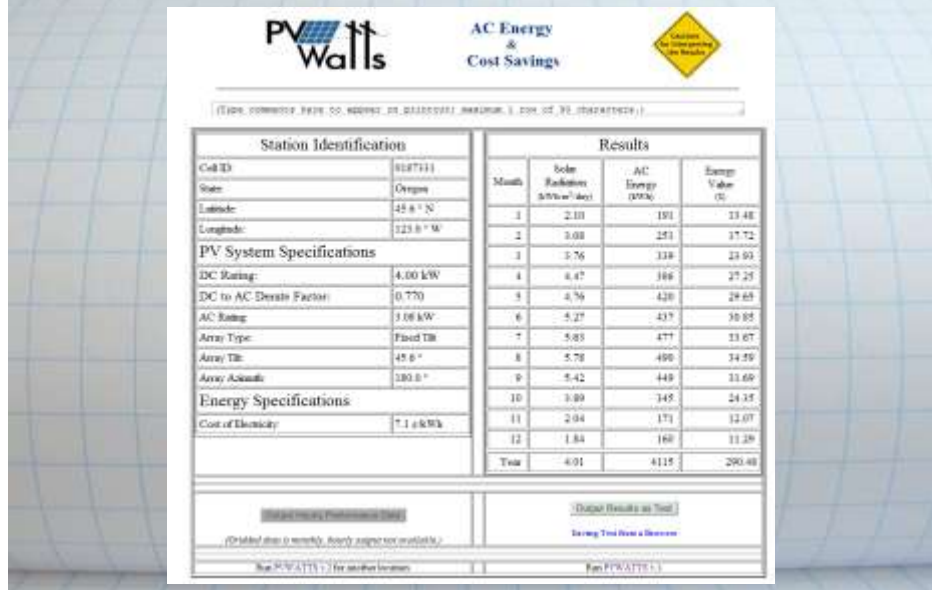


85% Map



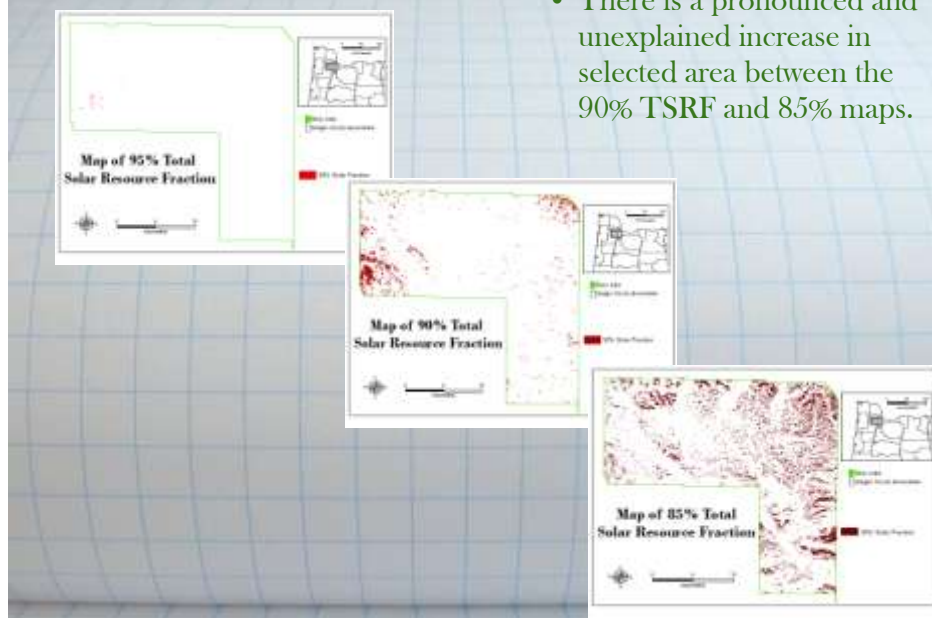
Conclusions

- Comparing results to NREL lends credibility to our methodologies



Continuing Questions:

- There is a pronounced and unexplained increase in selected area between the 90% TSRF and 85% maps.



Continuing Questions:

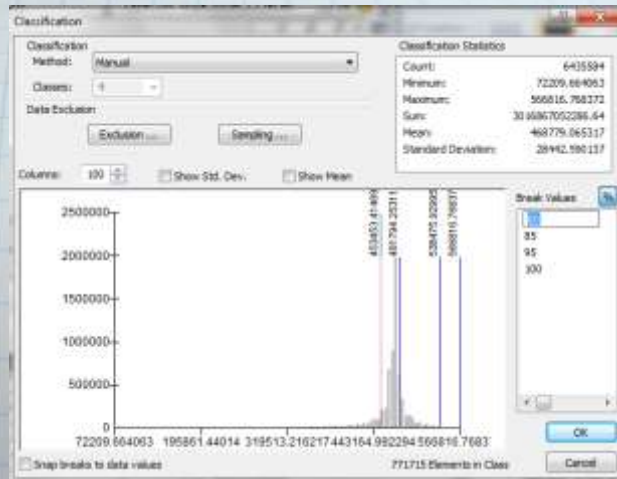
Mean average of solar radiation output is 82% of the maximum solar radiation output.

132,832 - total acreage of study area

5% .61 acres, no sites over an acre
4.592 * 10⁻⁴ % of total area

10% 72,93644 total acres. Maximum of 27.71 acres. 10 sites over 4 acres
0.055 % of total area

15% 10,637 of 421.8 acres. 589 sites over 4 acres. 8.008 % of total area



Conclusions :

- The ESRI Solar Radiation Tool works well but.....
 - TAKES A LONG TIME!
 - 8 to 12 hours
 - 2m DEM ran for 9 days and was not half complete.
 - Estimate for the 1 m DEM run just under 5 weeks.
- The LiDAR data provided an effective DEM for analysis
- The raster calculator was effective for extracting from streaming servers.

Conclusions :

- Developed methodologies to calculate solar potential based on criterion.
- Able to use LiDAR Derived DEM throughout the process.
 - Took into account terrain
 - Worked with raster calculator.
- Throughout the process valuable knowledge and information was gained.
 - **We Learned A LOT!**

Further Investigations:

- Additional exclusionary criteria:
 - Land use / availability
 - Proximity to solar energy conversion resources
 - Hazardous material investigation
- Calculations of possible energy outputs in selected areas.
- Use NREL data and tools.
 - Use of meteorology data.
- Make use of the ESRI Point Solar Radiation tool.
- Set custom parameters on Area Solar Radiation tool

Thank You to Lynn Averbeck and Alsea Geospatial, Inc.!



Questions?

<http://solaroregon.org/news/pacific-power-announces-solar-farm-plans/image>