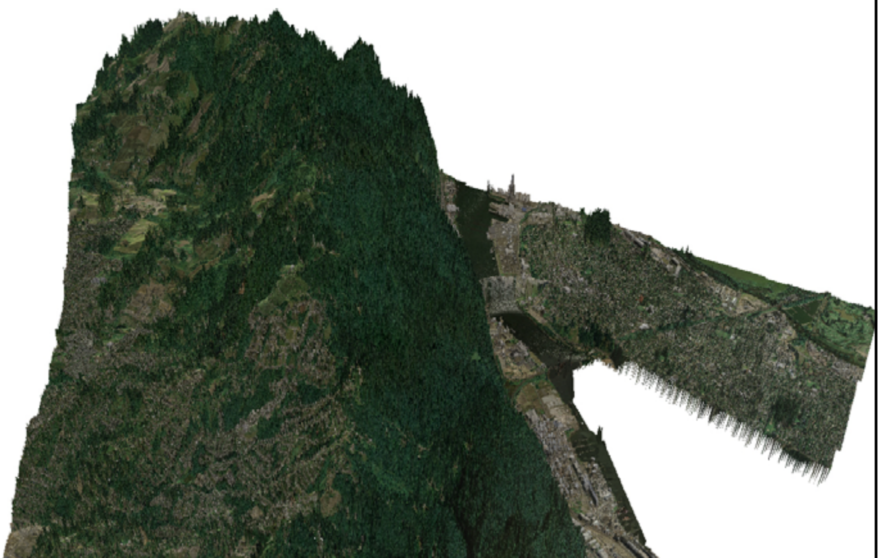


Risk Analysis of Invasive Species in Forest Park, Portland OR

A presentation by: Aaron Reyna, Al Klein, Jeremy Crawford

Question?

- What are the factors that affect the growth of invasive species?
- What areas of Forest Park are at the greatest risk?
- How does the risk map compare to observations in the field?

Methodology  (to the madness)

MCE Risk Model

1. Identified the factors that pertain to invasive species propagation
2. Created datasets of each of the factors
3. Standardized using Idrisi Andes FUZZY function
4. Weighted factors using Analytic Hierarchy Process
5. Combined factors using Raster Calculator to produce risk map
6. Compared risk maps to field observation to test accuracy

CAUTION

- **Himalayan Blackberry**
- **English Ivy**

Rubus discolor

Hedera helix

Factors

- Solar Exposure
- Aspect
- Slope
- Soil Permeability
- Trail Edge
- Distance from Houses

Factors

English Ivy

- Solar Exposure
- Distance from Houses
- Trail Edges

Himalayan Blackberry

- Solar Exposure
- Distance from Houses
- Trail Edges
- Slope

'Plant X'

- Solar Exposure
- Trail Edges
- Slope
- Aspect
- Soil Permeability

Data Acquisition

- LiDAR (First Return and Bare Earth): City of Portland
- Soils: NRCS
- Tax lots and Park: RLIS

Solar Exposure (The Process)

A couple of questions:

How do you begin to build a map of solar exposure?

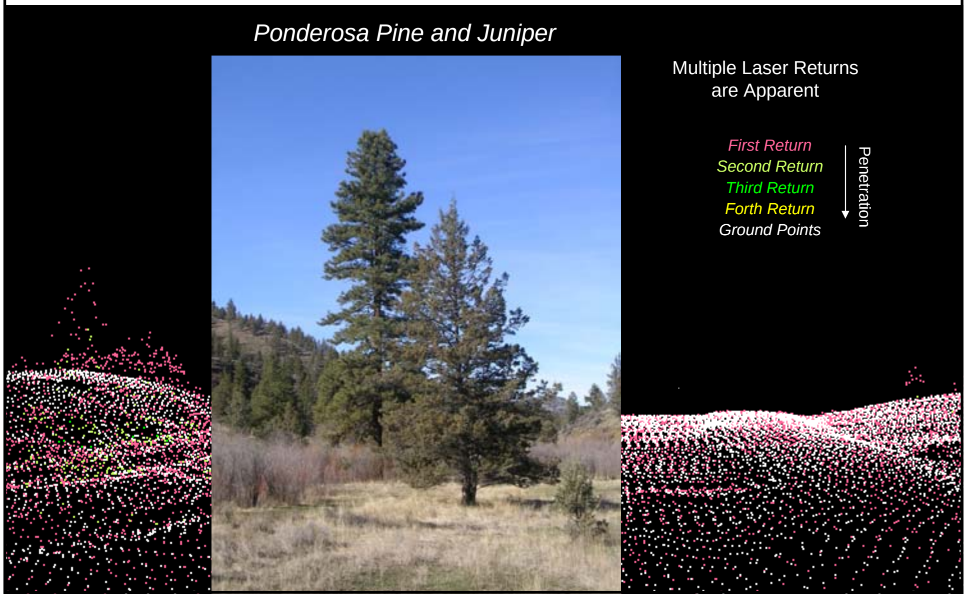
How do you build an incredibly accurate map of solar exposure?

LiDAR

In its most basic form, LiDAR Data are points (data clouds)

Cross Section of LiDAR points d/s of Deer Creek

*Source: watershed sciences

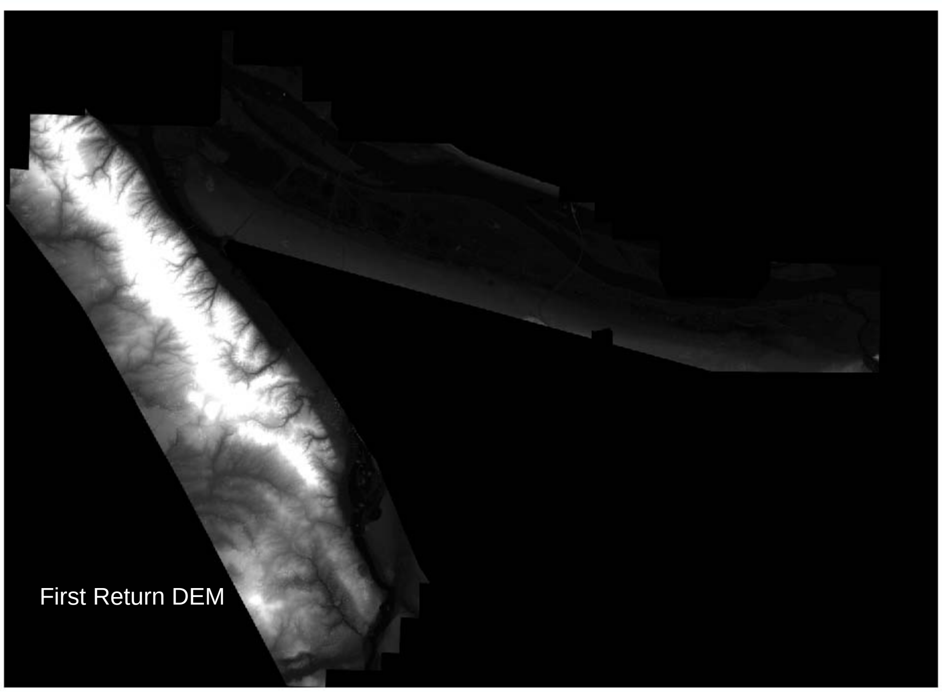


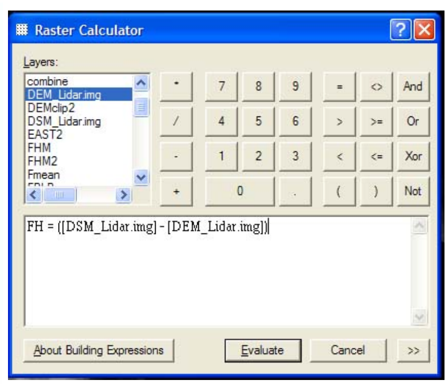
*Source: watershed sciences

bare earth LiDAR data. Dam on Clackamas River near Estacada, OR.

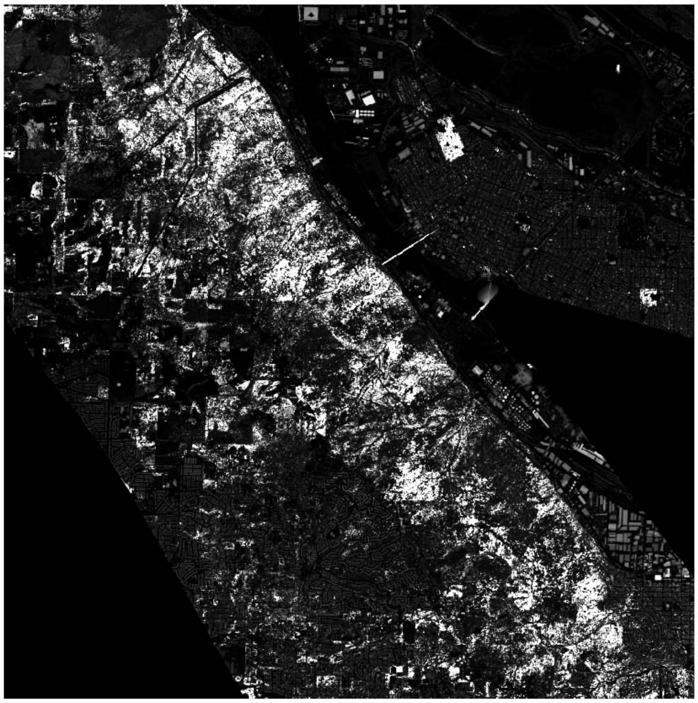
*Source: watershed sciences

Dam on Clackamas River near Estacada, OR. First Return LiDAR data.





By subtracting the Ground Model from the First Return, you end up with a flat surface depicting the feature height of any given surface.

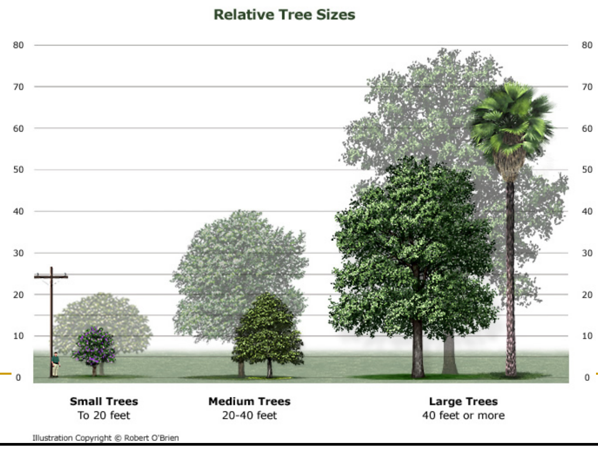


Feature Height:
Vertical exaggeration = 10

What's Next?

Next we want to determine the how varied our feature data is and we want to begin to build a map of places that have the same feature height, as well a map of the most varied feature height.

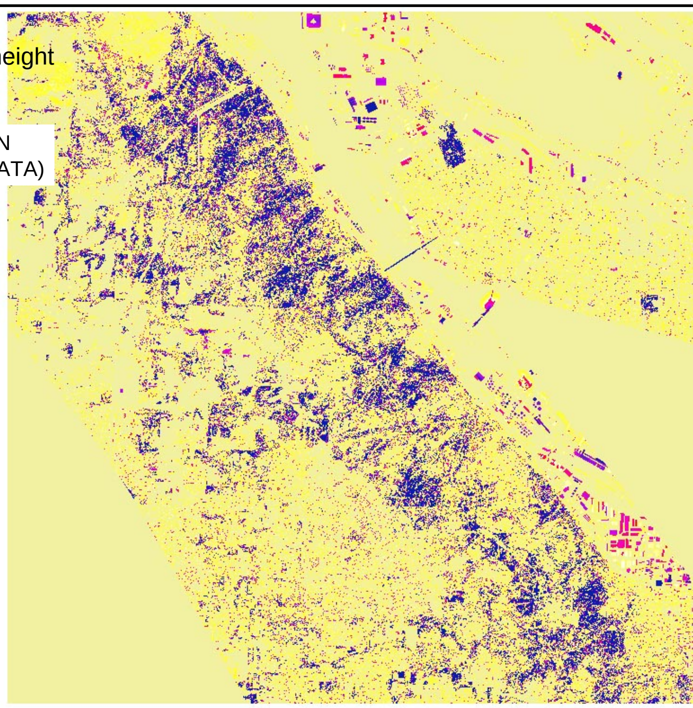
Why? Because we are assuming that tree height and variability are related to solar exposure.



Places of similar height

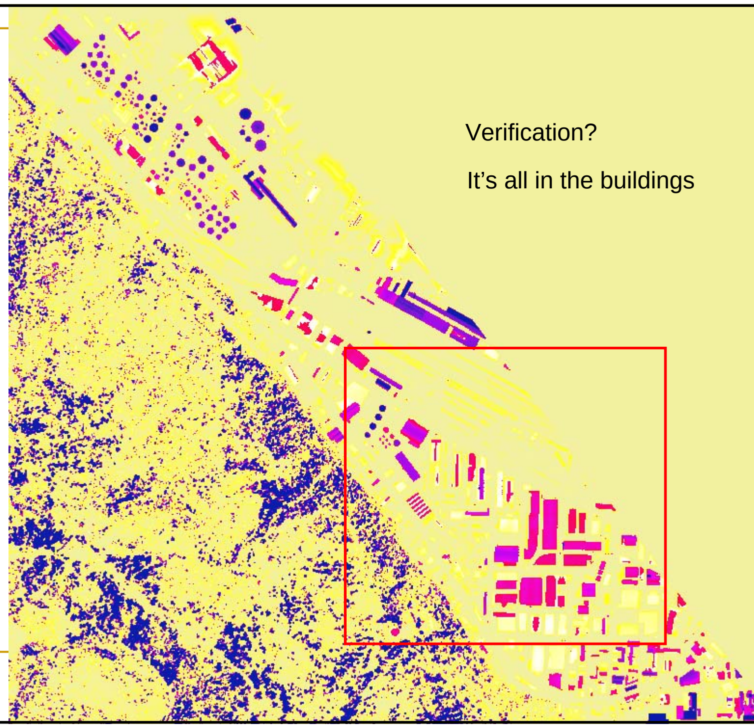
Focal Mean

F_mean = FOCALMEAN ([FH], CIRCLE, 4, NODATA)



Verification?

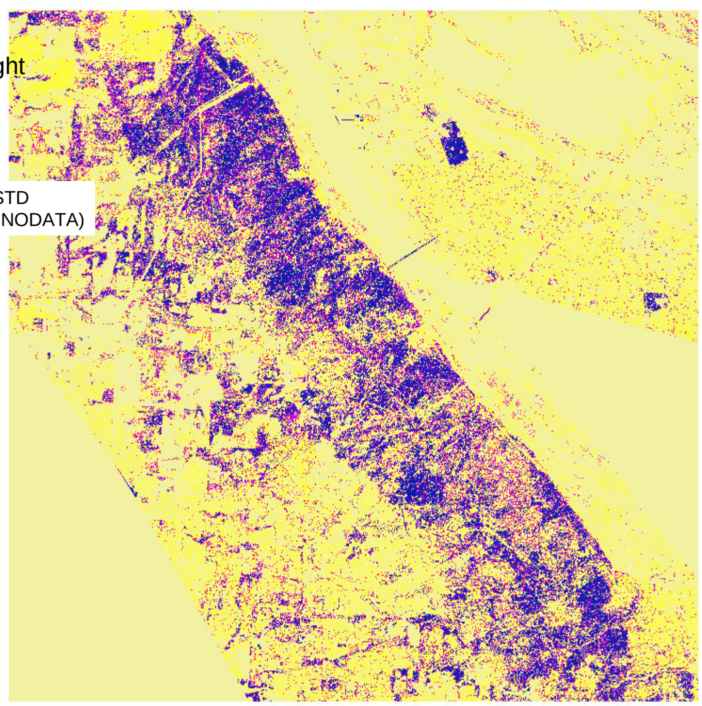
It’s all in the buildings



Places of varied height

FocalSTD

F_STD = FOCALSTD ([FH], CIRCLE, 4, NODATA)



Verification?

Again… in the buildings

Then, Reclassification

Why?

•Data is too spread out (stretched 0-N). It needs to be aggregated (i.e. broken down into smaller, manageable classes)

Focal Mean

Places of similar height

Low	1
Low-medium	2
Medium-high	3
High	4

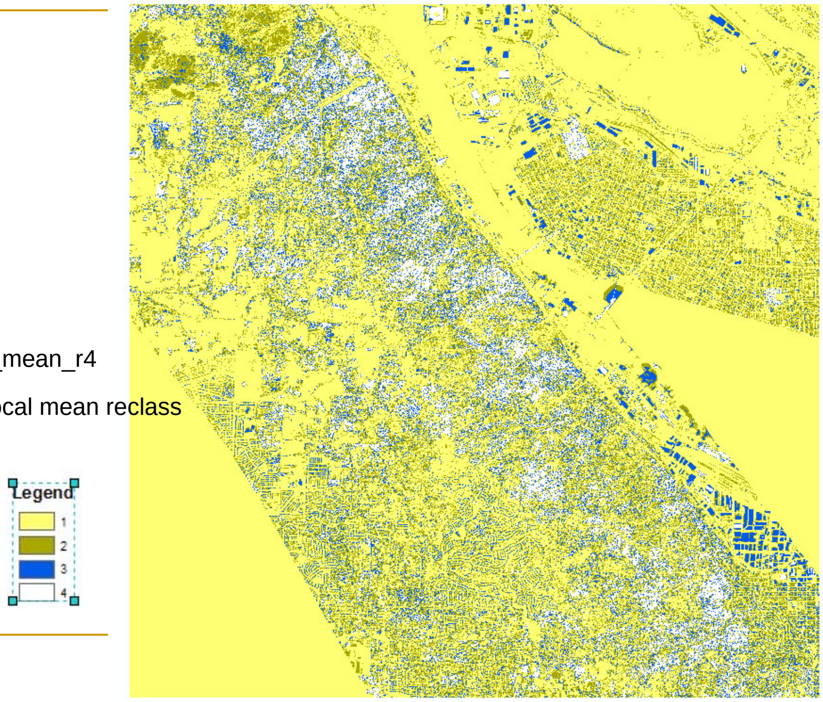
Focal STD

Places of varied height

Low	1
Low-medium	2
Medium-high	3
High	4

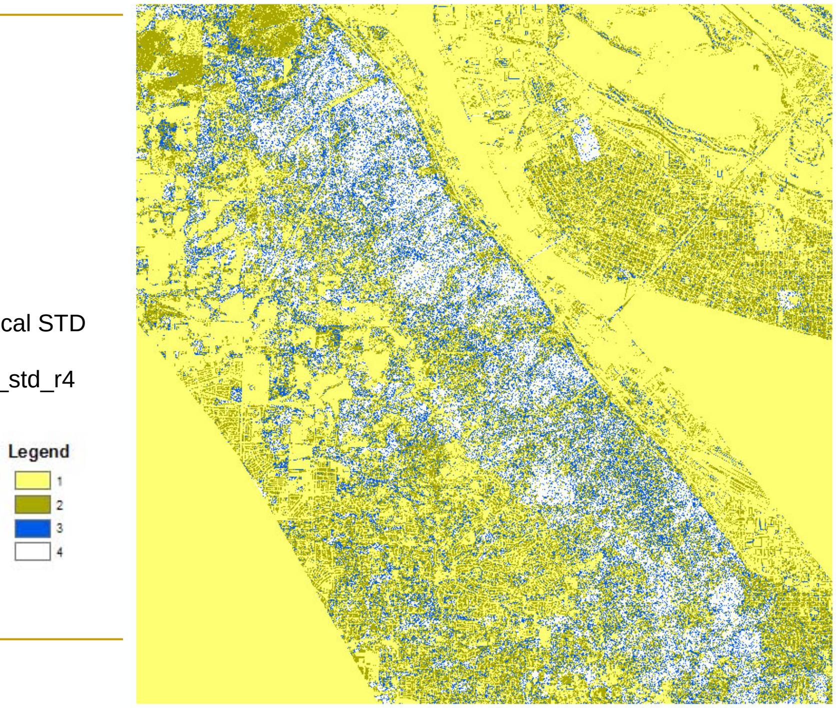
F_mean_r4

Focal mean reclass

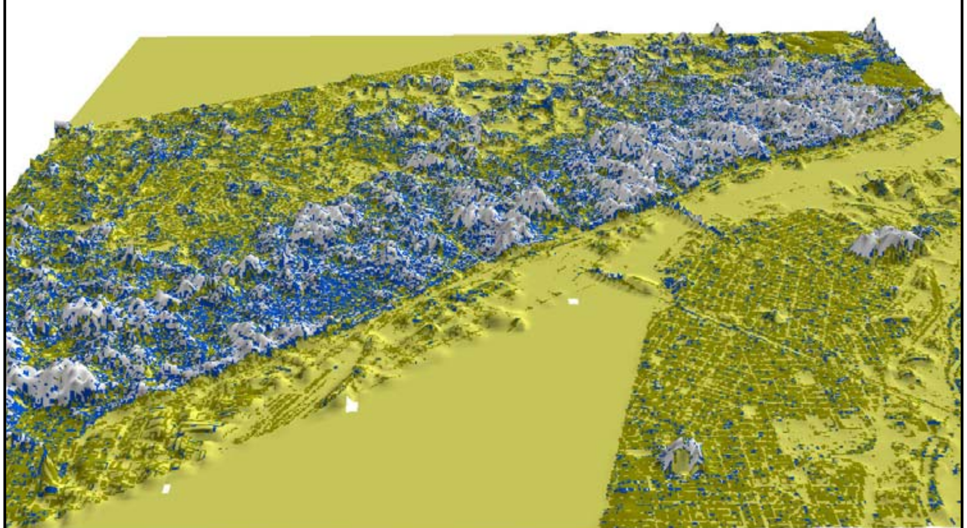


Focal STD

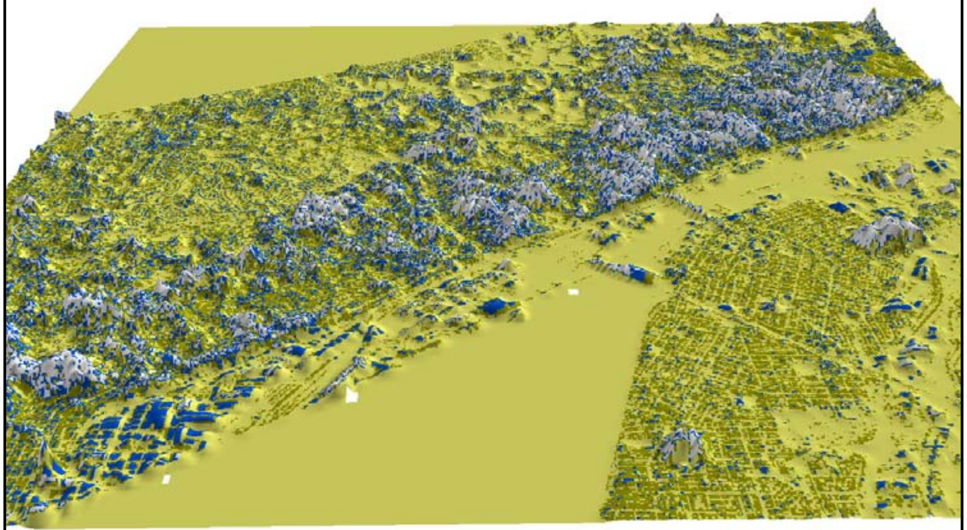
F_std_r4



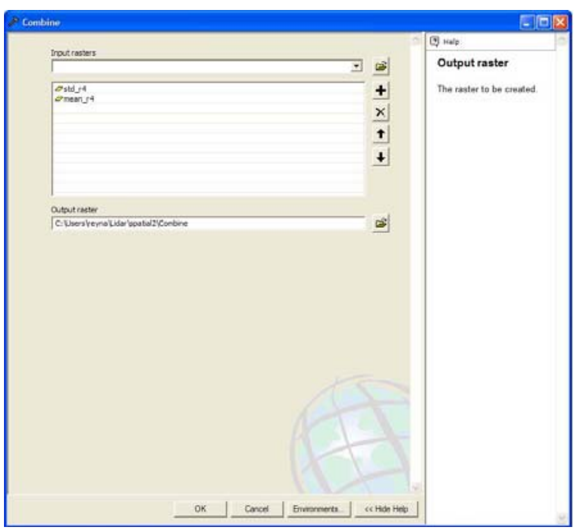
Focal STD

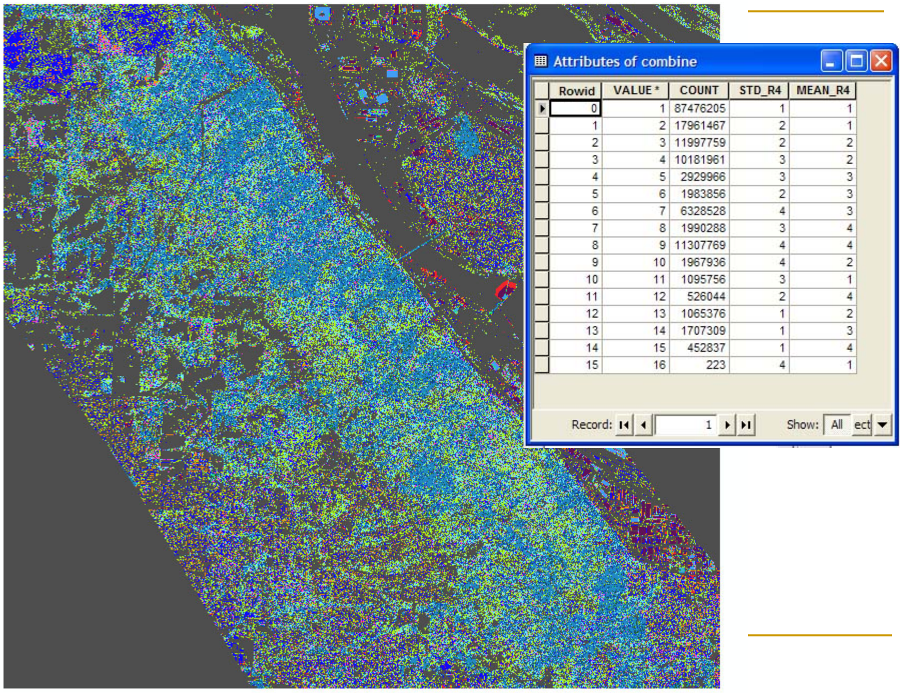


Focal mean



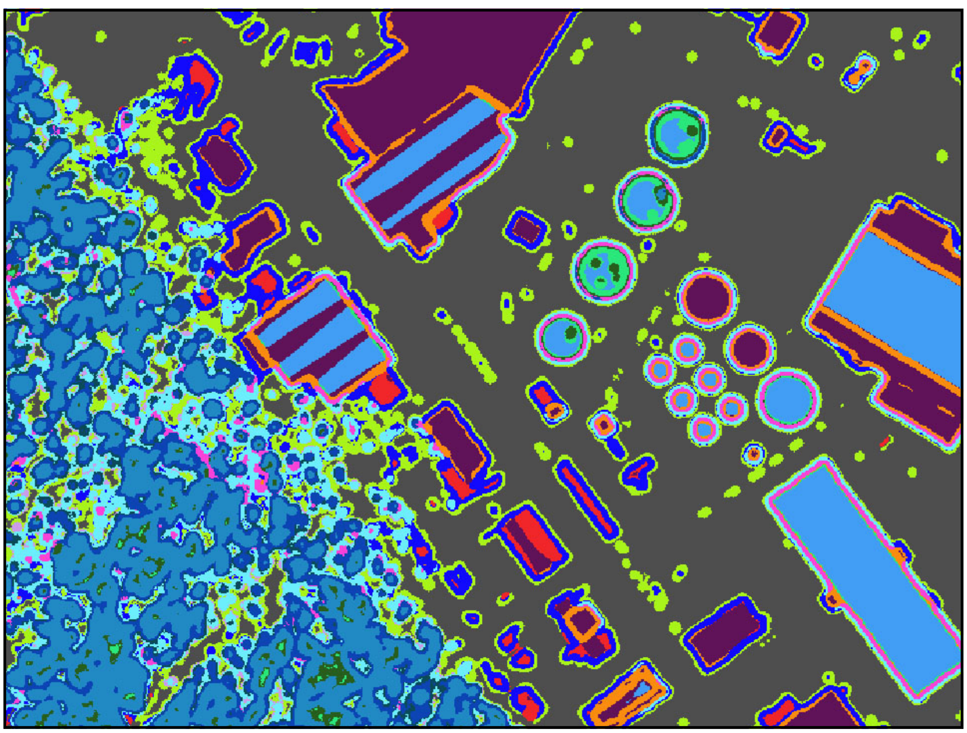
COMBINE TOOL



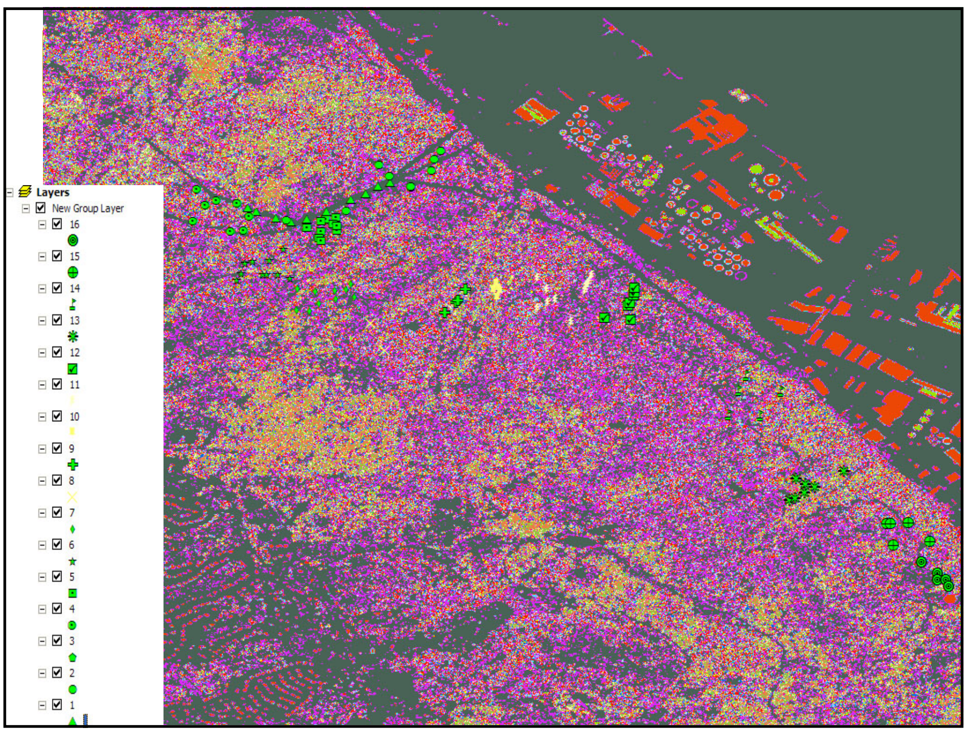


Attributes of combine

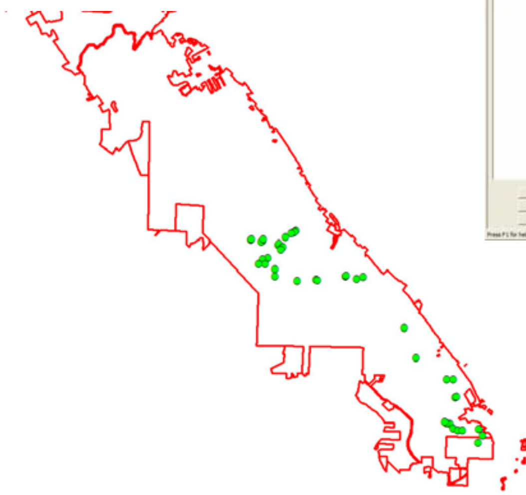
Rowid	VALUE *	COUNT	STD_R4	MEAN_R4
0	1	87476205	1	1
1	2	17961467	2	1
2	3	11997759	2	2
3	4	10181961	3	2
4	5	2929966	3	3
5	6	1983856	2	3
6	7	6328528	4	3
7	8	1990288	3	4
8	9	11307769	4	4
9	10	1967936	4	2
10	11	1095756	3	1
11	12	526044	2	4
12	13	1065376	1	2
13	14	1707309	1	3
14	15	452837	1	4
15	16	223	4	1

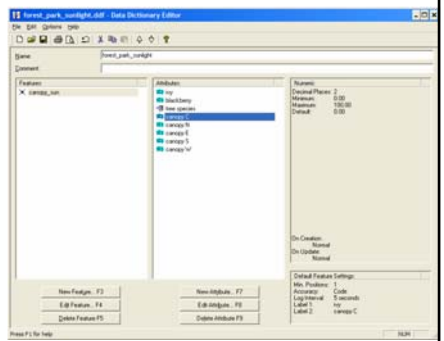


From here we can export 16 different classes based on mean height and varying height

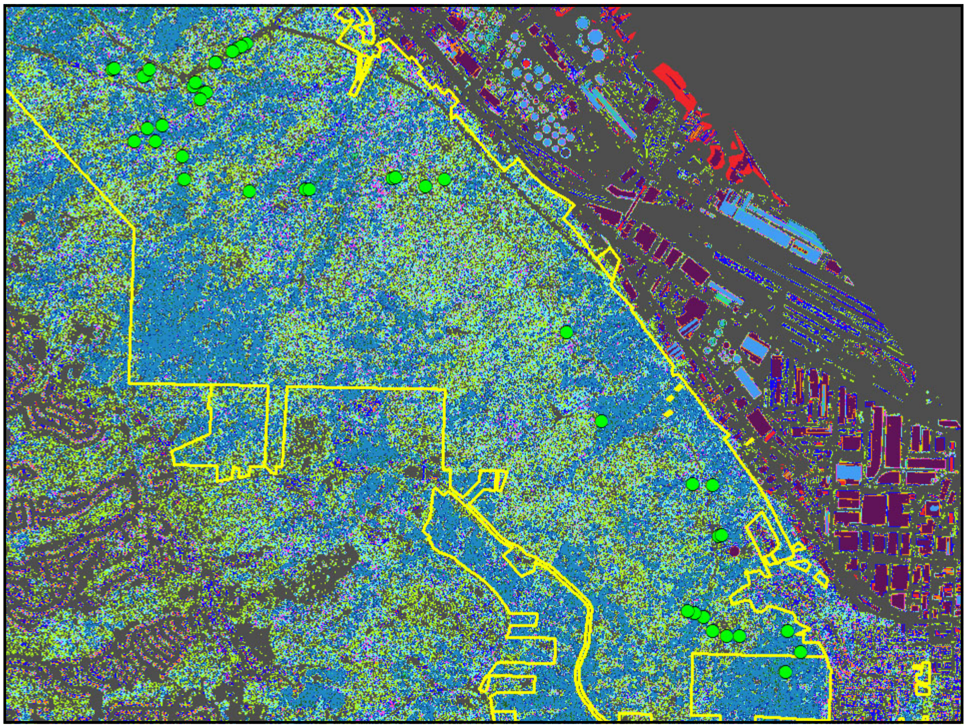


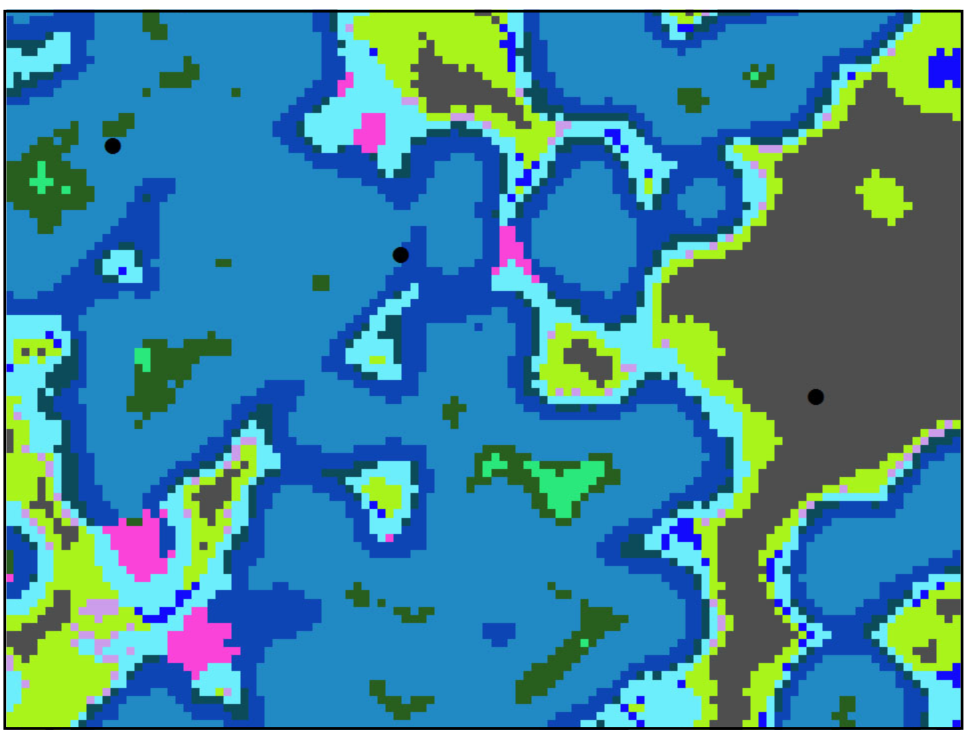
Field Observations

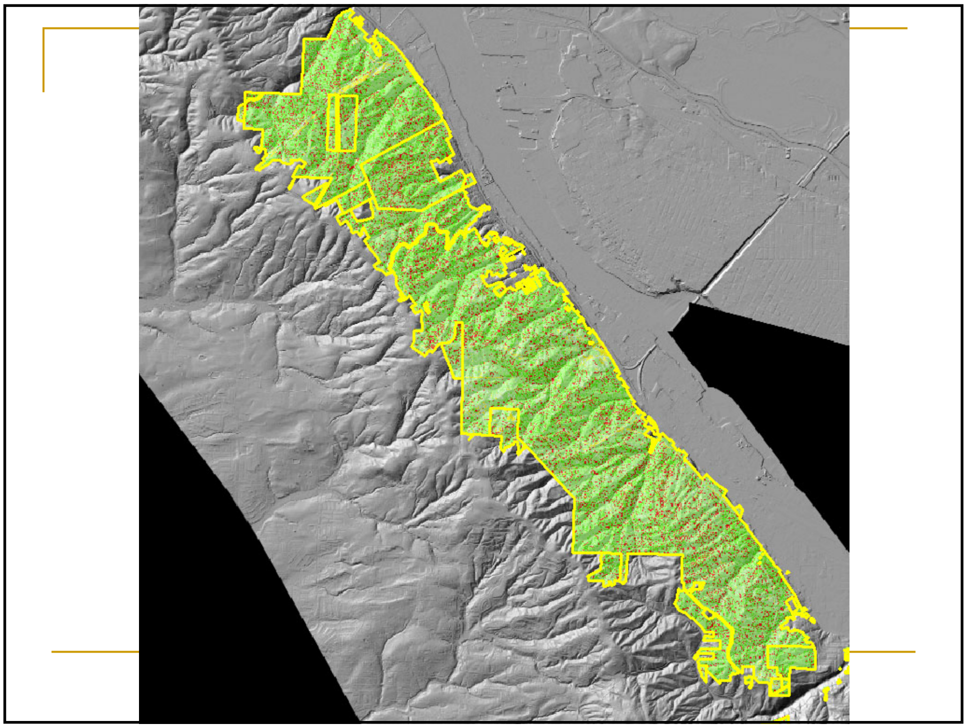




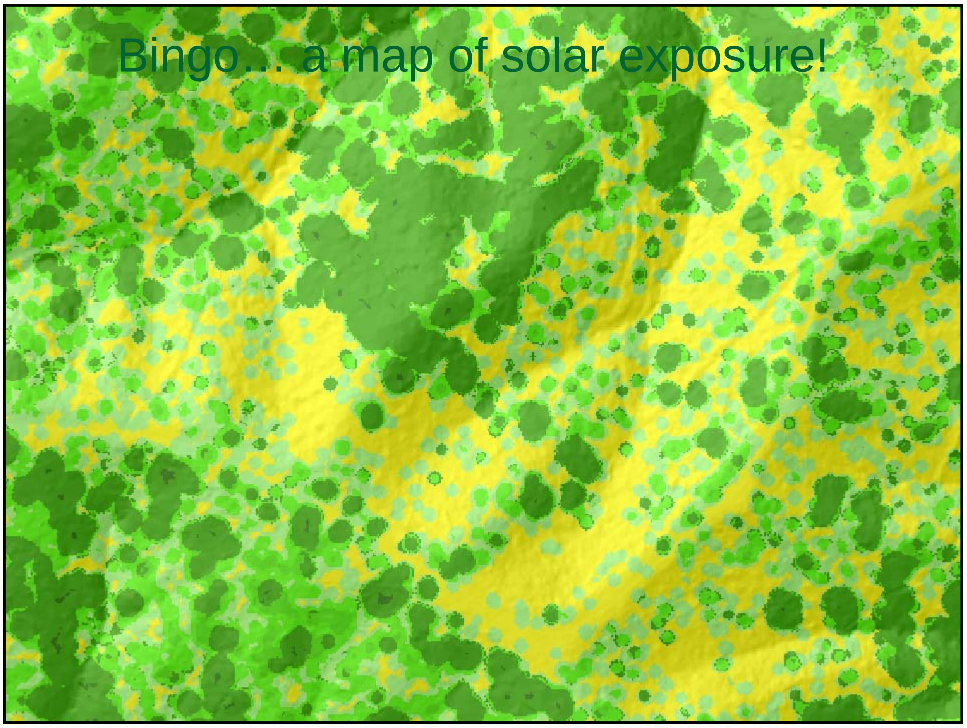
Solar Exposure Data Collection



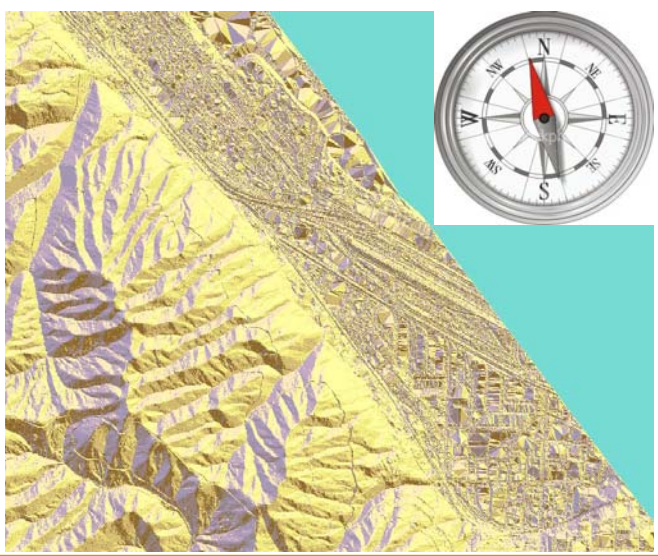




Bingo… a map of solar exposure!



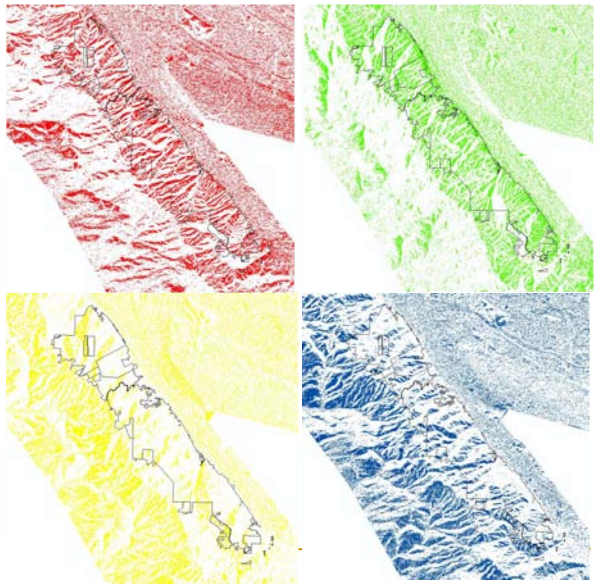
Aspect



Aspect (cont.)

North

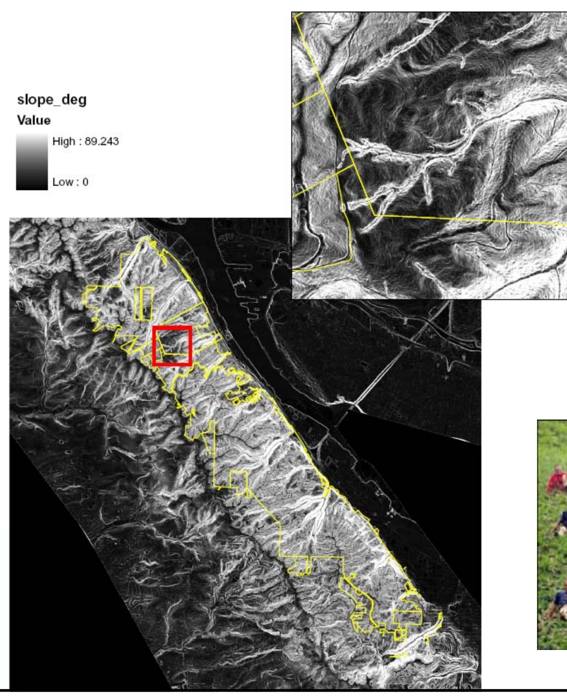
East



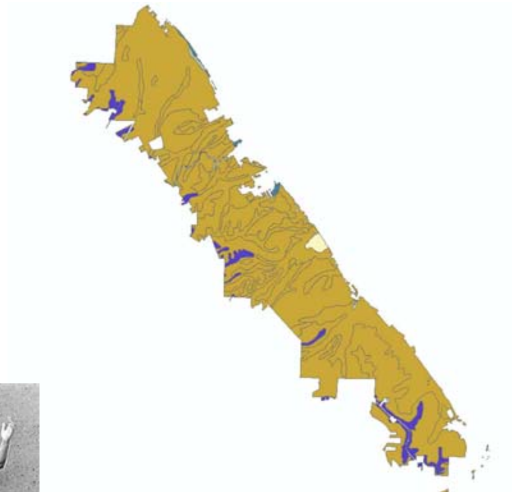
West

South

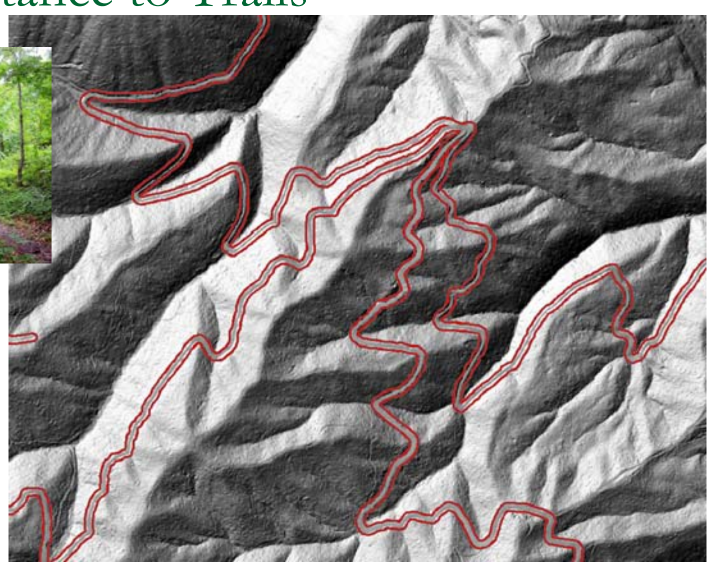
Slope



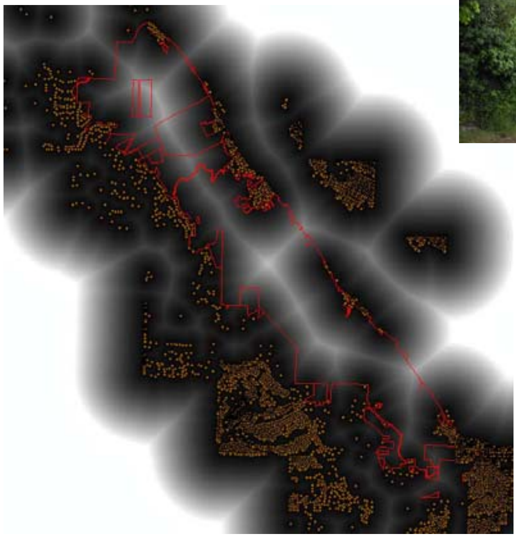
Soil Permeability



Distance to Trails



Distance to Houses



Rescaling the Data

- Datasets rescaled to values between 0 and 1.
- 0=Low Risk, 1=High Risk
- Used Reclass and FUZZY

English Ivy

Solar Exposure :
a =100%
b = 0%

Trails: 0 or 1 reclass

Houses: c = 300ft
d = ½ mile

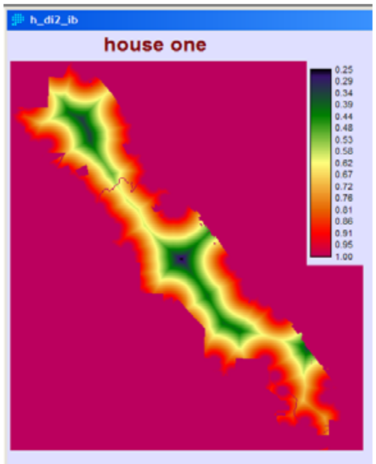
Himalayan B-berry

Solar Exposure :
c = 100%
d = 0%
Trails: 0 or 1 reclass
Houses: c = 300ft
d = ½ mile
Slope: a = 0°
b = 45°
c = 70°
d = 90°

'Plant X'

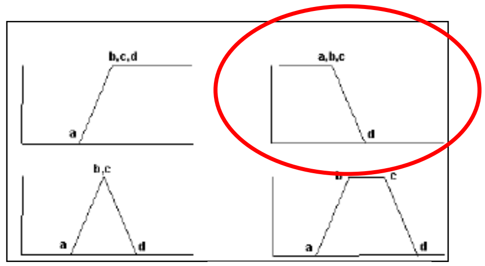
Solar Exposure :
c = 100%
d = 90%
Trails: 0 or 1 reclass
Slope: a = 25°
b = 40°
c = 60°
d = 75°
Aspect: N = 1 E,S,W = 0
Soil Permeability:
a = Low
b = High

Fuzzy Example



Houses: c = 300ft
d = ½ mile

- Convert Raster to ASCII
- Import ASCII to IDRISI raster
- Perform FUZZY
- Export FUZZY data to ESRI format
- Define Projection in ArcMap



a = membership rises above 0
b = membership becomes 1
c = membership falls below 1
d = membership becomes 0

Analytic Hierarchy Process (AHP)
(Saaty 1980)

Pairwise comparisons:
To determine the weights for A, B, C

How important is *A* relative to *B*?	Preference index assigned
Equally important	1
Moderately more important	3
Strongly more important	5
Very strongly more important	7
Overwhelmingly more important	9

	A	B	C
A	1	5	9
B	1/5	1	3
C	1/9	1/3	1

Criterion	Geometric mean	Weight
A	$(1*5*9)^{1/3} = 3.5569$	0.751
B	$(1/5*1*3)^{1/3} = 0.8434$	0.178
C	$(1/9*1/3*1)^{1/3} = 0.3333$	0.071
Sum	4.7337	1

Analytical Hierarchy Process Factor Weights

Rubus Discolor BERRY	sun	trails	houses	slope	geometric mean	
Solar Ex	1.000	3.000	9.000	7.000	3.707793	0.597639
Trails	0.333	1.000	5.000	5.000	1.699044	0.27386
Houses	0.111	0.200	1.000	1.000	0.386097	0.062233
Slope	0.143	0.200	1.000	1.000	0.411134	0.066268
					6.204068	1

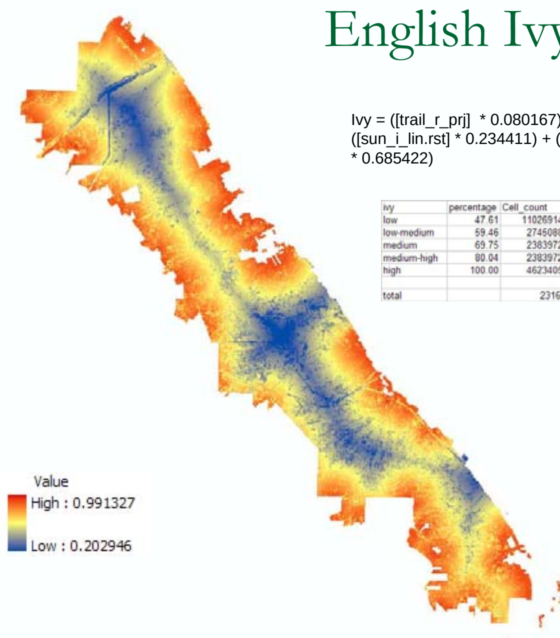
Hedera helix IVY	sun	trails	houses	geometric mean	
Solar Ex	1.000	5.000	0.200	1	0.234411
Trails	0.200	1.000	0.200	0.341995	0.080167
Houses	5.000	5.000	1.000	2.924018	0.685422
				4.266013	1

X	sun	trail	Permeability	slope	aspect	geometric mean	
Solar Ex	1.000	7.000	5.000	9.000	1.000	3.159818	0.503293
Trail	0.143	1.000	0.200	7.000	0.333	0.581811	0.09267
Permeability	0.200	0.200	1.000	3.000	5.000	0.90288	0.14381
Slope	0.111	0.143	0.333	1.000	0.200	0.254047	0.040464
Aspect	1.000	5.000	0.200	5.000	1.000	1.37973	0.219762
						6.278286	1

English Ivy (Hedera Helix)

Ivy = ([trail_r_prj] * 0.080167) + ([sun_i_lin.rst] * 0.234411) + ([h_di2_ib.rst] * 0.685422)

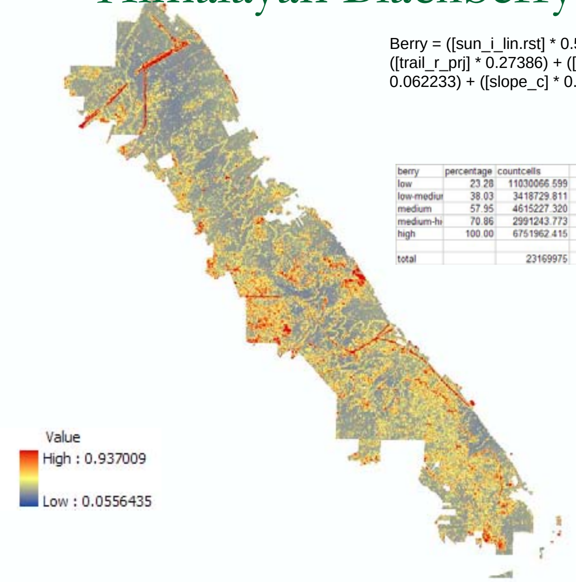
ivy	percentage	Cell_count		meterssquare
low	47.61	11026914.196	47.61	9219904.66
low-medium	59.46	2745088.964	11.85	2295243.99
medium	69.75	2383972.291	10.29	1993304.46
medium-high	80.04	2383972.291	10.29	1993304.46
high	100.00	4623405.259	19.96	3865755.63
total		23163353	100	19367513.19



Himalayan Blackberry (Rubus Discolor)

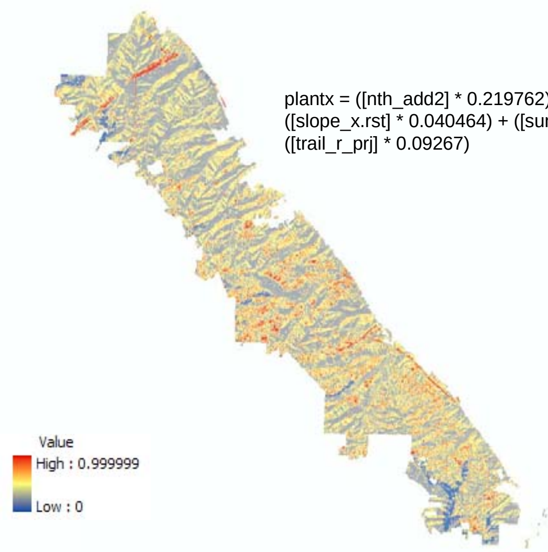
Berry = ([sun_i_lin.rst] * 0.597639) + ([trail_r_prj] * 0.27386) + ([h_di2_ib.rst] * 0.062233) + ([slope_c] * 0.066268)

berry	percentage	countcells		meterssquare
low	23.28	11030066.599	47.61	9222540.47
low-mediu	38.03	3418729.811	14.76	2858493.53
medium	57.95	4615227.320	19.92	3858917.84
medium-hi	70.86	2991243.773	12.91	2501060.76
high	100.00	6751962.415	29.14	5645500.51
total		23169975	100	19373050.03

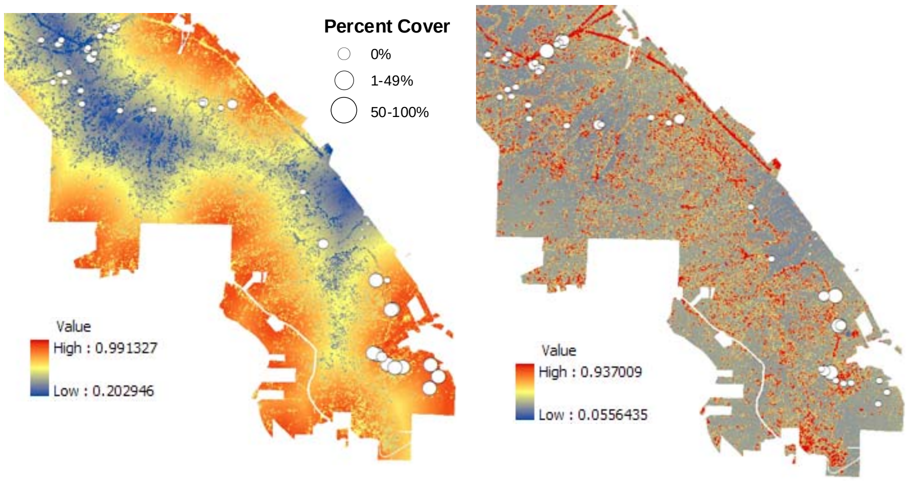


Plant X

plantx = ([nth_add2] * 0.219762) + ([perm_x.img] * 0.14381) + ([slope_x.rst] * 0.040464) + ([sun_x] * 0.503293) + ([trail_r_prj] * 0.09267)



Observed



Stats

- **Himalayan Blackberry**

Descriptive Statistics

	Mean	Std. Deviation	N
Blackberry	1.4186	.73136	43
Risk_Factor_Berry	.3941	.21938	43

Correlations

		Blackberry	Risk_Factor_Berry
Blackberry	Pearson Correlation	1	.343*
	Sig. (2-tailed)		.024
	N	43	43
Risk_Factor_Berry	Pearson Correlation	.343*	1
	Sig. (2-tailed)	.024	
	N	43	43

*. Correlation is significant at the 0.05 level (2-tailed).

- **English Ivy**

Descriptive Statistics

	Mean	Std. Deviation	N
English_Ivy	1.6512	.86969	43
Risk_Factor_Ivy	.6216	.15044	43

Correlations

		English_Ivy	Risk_Factor_Ivy
English_Ivy	Pearson Correlation	1	.765**
	Sig. (2-tailed)		.000
	N	43	43
Risk_Factor_Ivy	Pearson Correlation	.765**	1
	Sig. (2-tailed)	.000	
	N	43	43

**. Correlation is significant at the 0.01 level (2-tailed).

What the model says

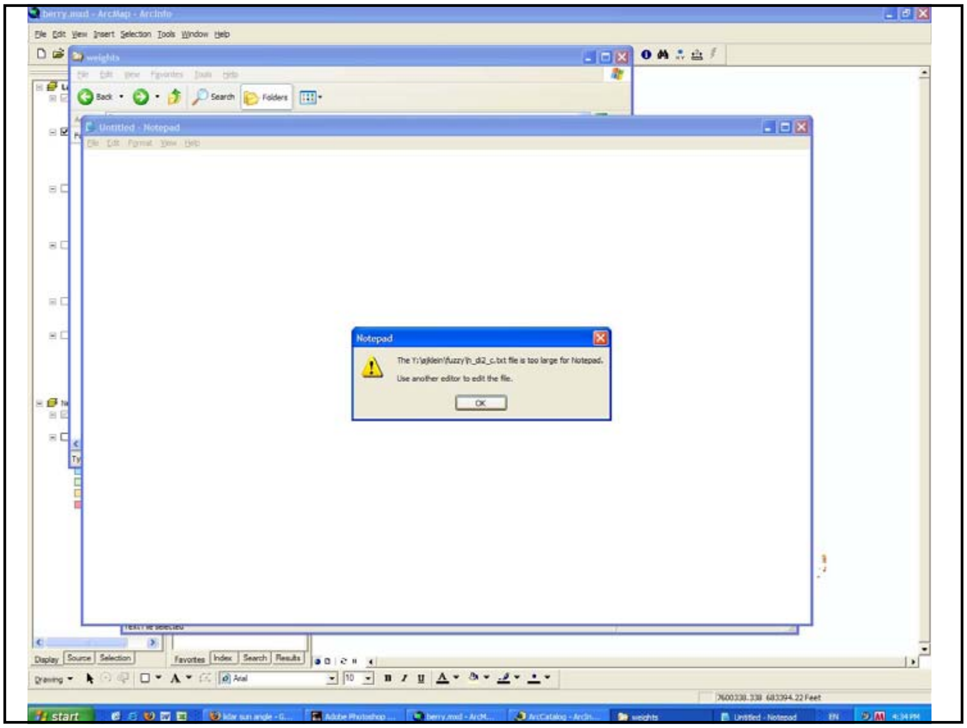
- Displays the relative risk suitability of the modeled invasive species throughout Forest Park
- Can be used to maximize efficiency of identification and removal

What the model doesn't say

- The location of the invasive species at present

Limitations

- We would like to have taken more samples in the field
- LIDAR data Azimuth
- Knowledge of vegetation
- Files size of all data and analysis time
- Time of presentation (total hours of research and analysis completed, 160+)
- Power outage CH469



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