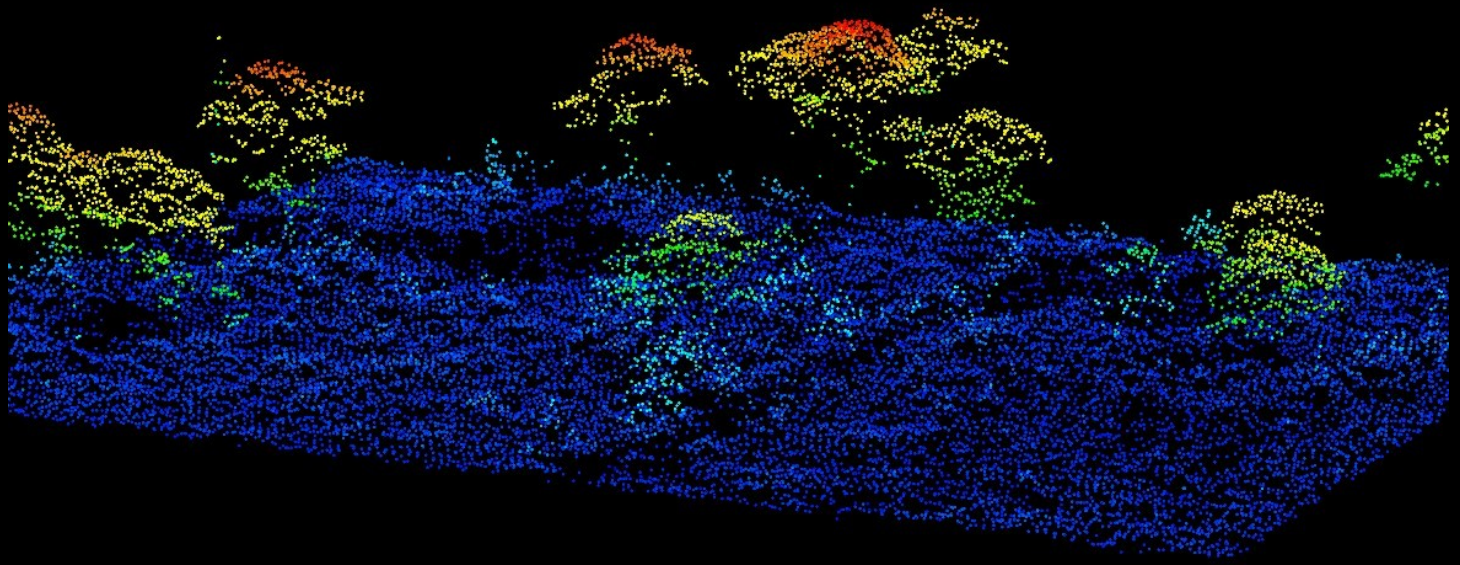
Using lidar remote sensing and support vector machines to classify fire disturbance legacies in a Florida oak scrub landscape



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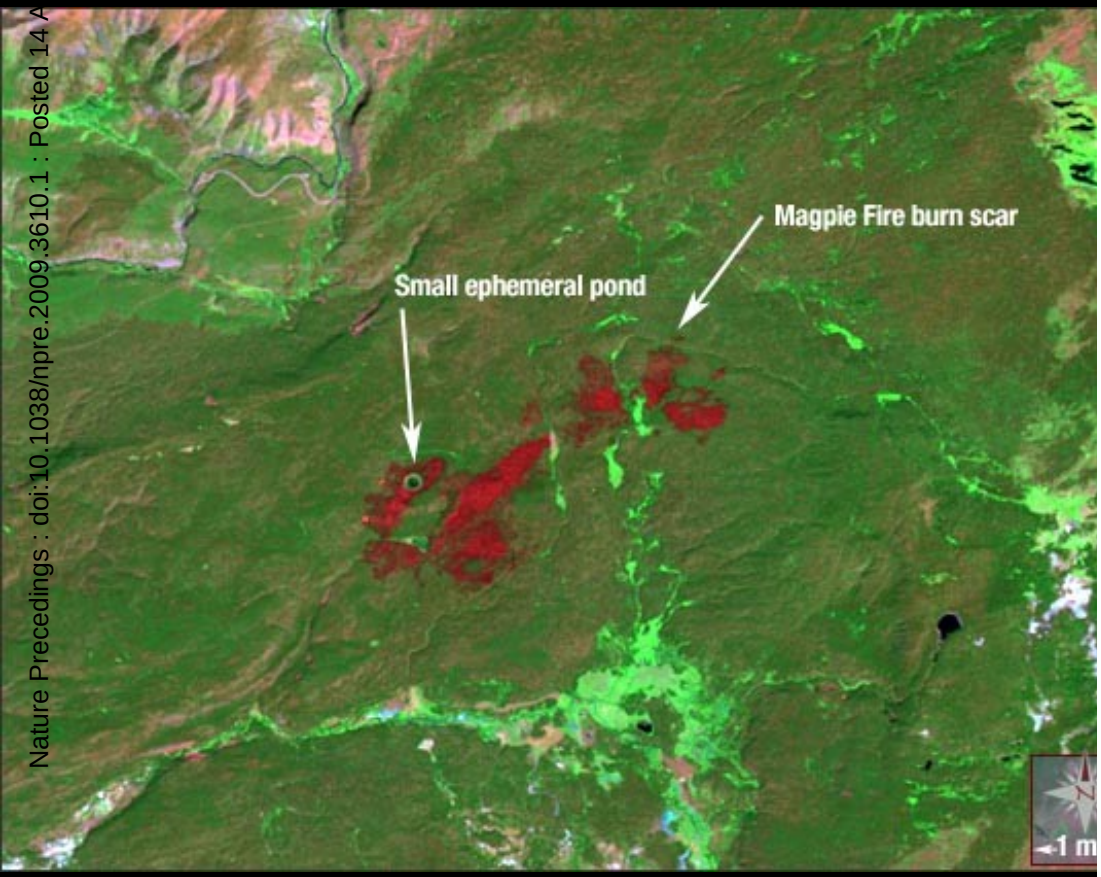
The Extended Keystone Hypothesis

- Terrestrial ecosystems are organized by a small set of ecological processes (Holling 1992, *Ecological Monographs* **62**:447-502)
- "Contagious disturbance processes" dominate at the *mesoscale*

Florida Oak Scrub

- Requires frequent burning to maintain physiognomy

Remote Sensing of Fire Legacies

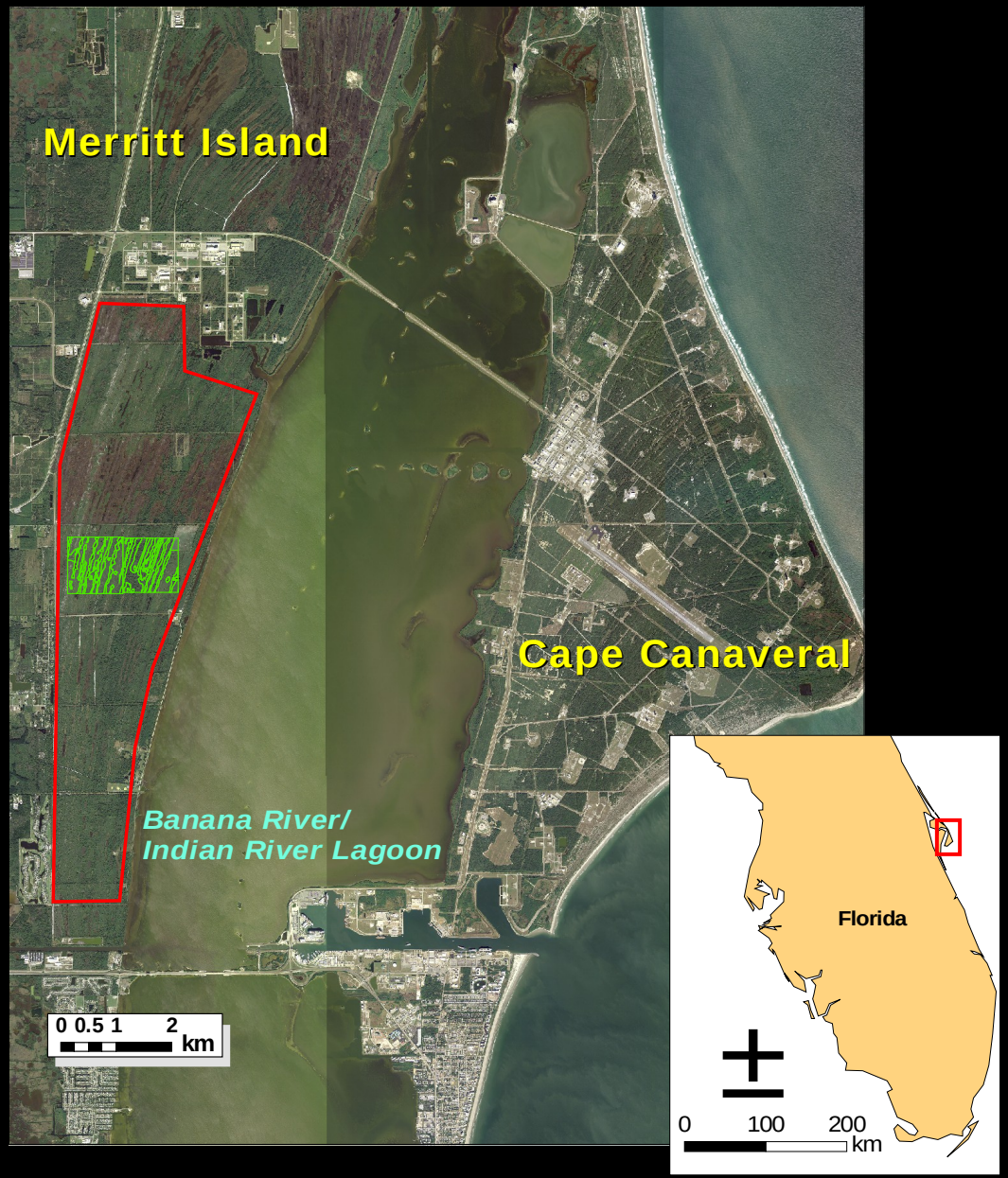


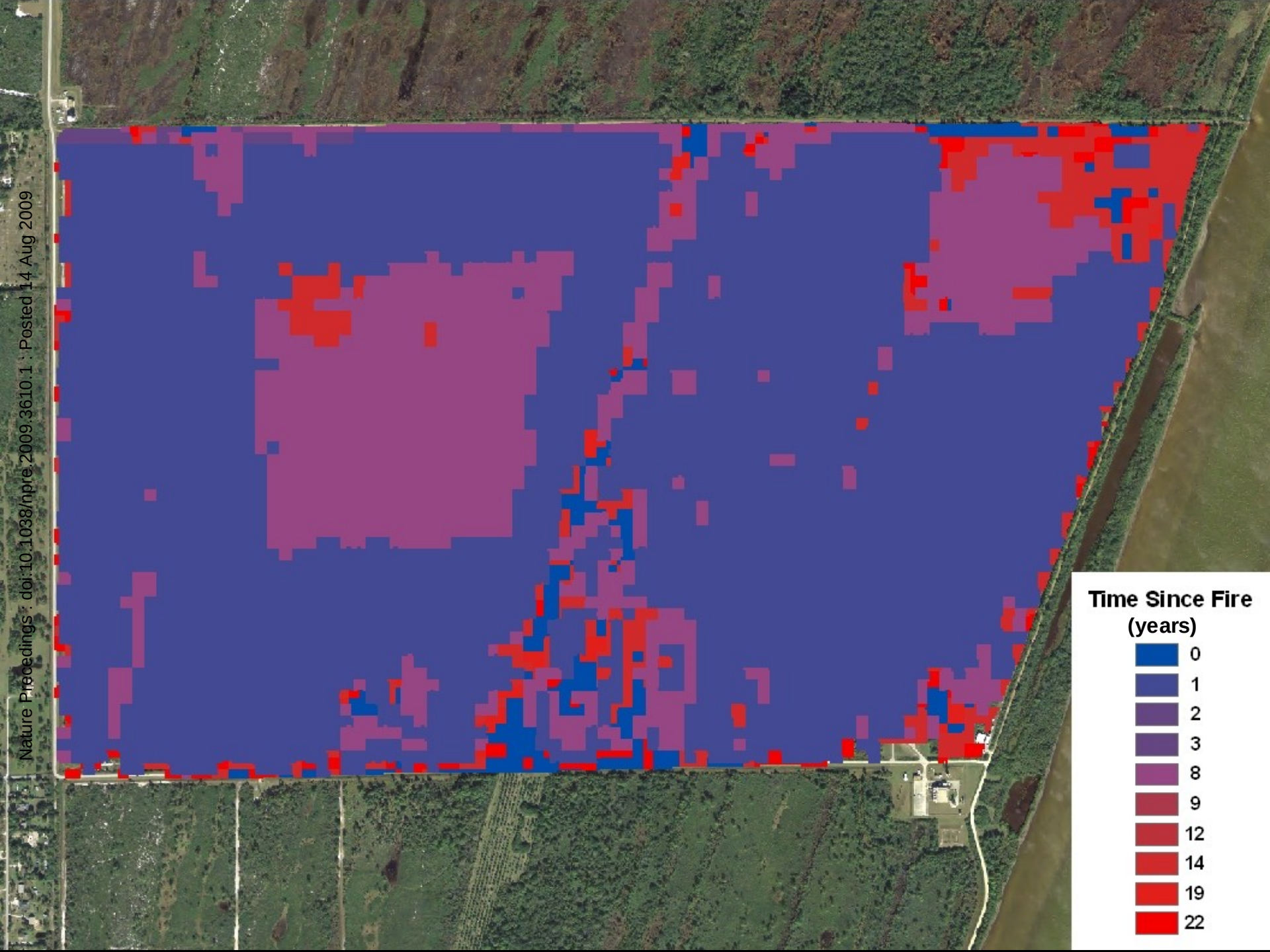
Study Objectives

1) Determine the effectiveness of using lidar data to predict time since fire (TSF)

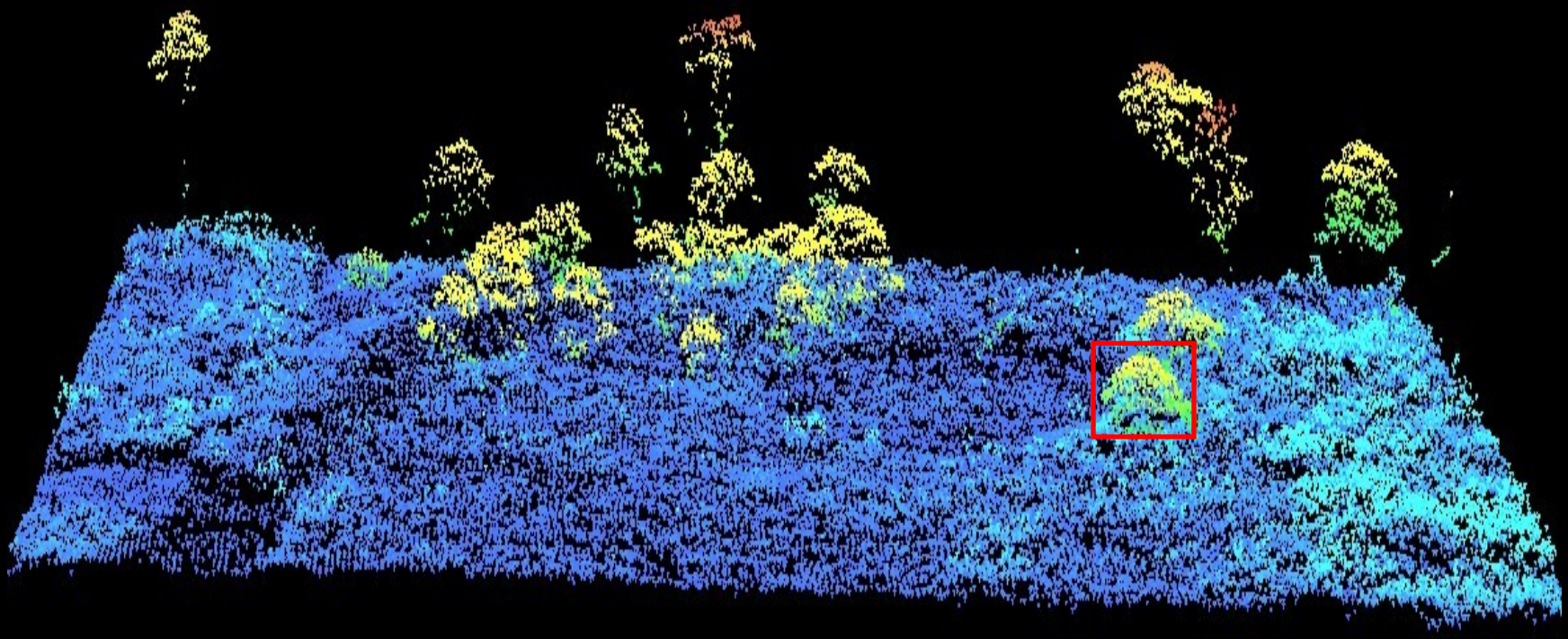
3) Estimate the amount of “ground-truth” data necessary to achieve satisfactory accuracy

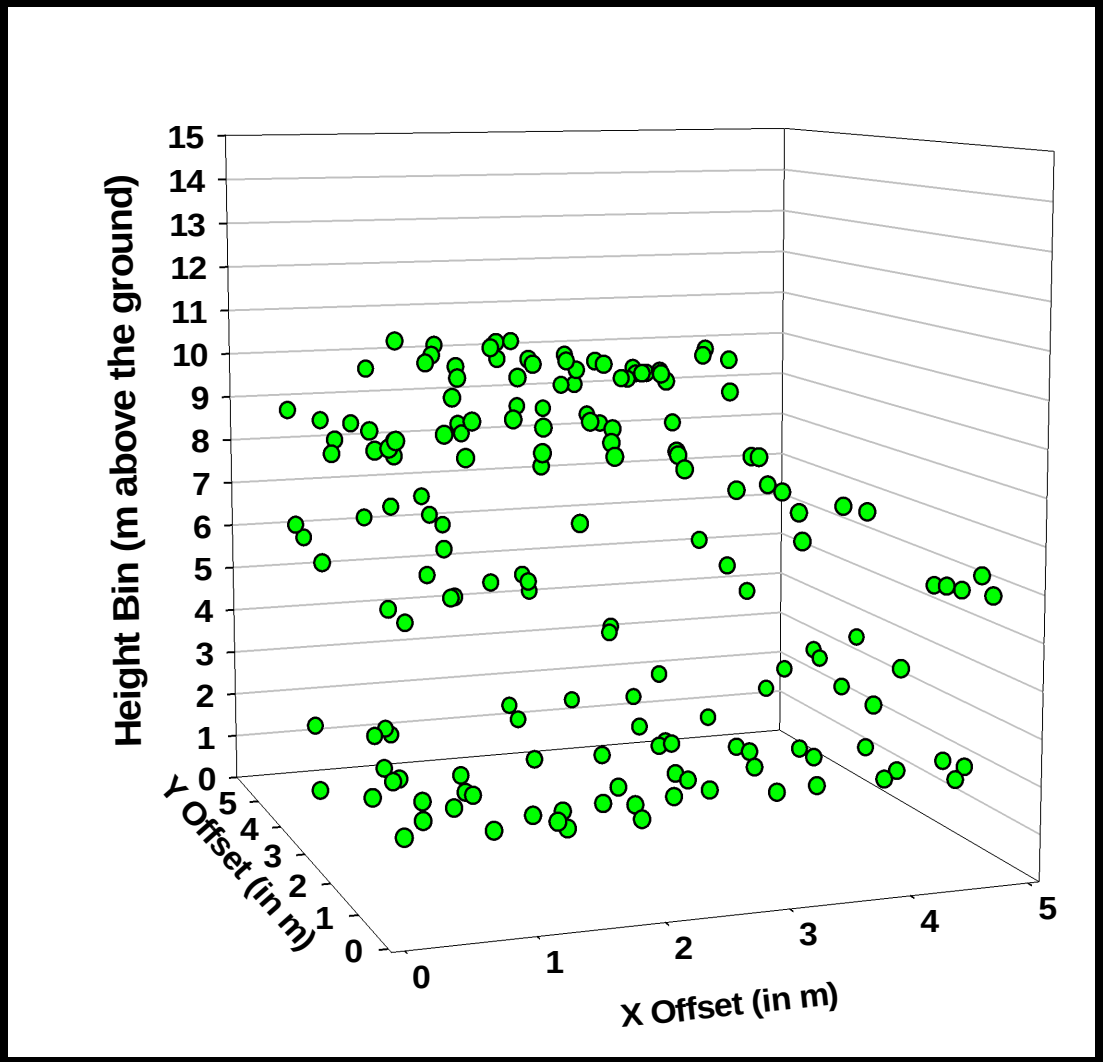
KSC/MINWR Study Area





Lidar Data Processing

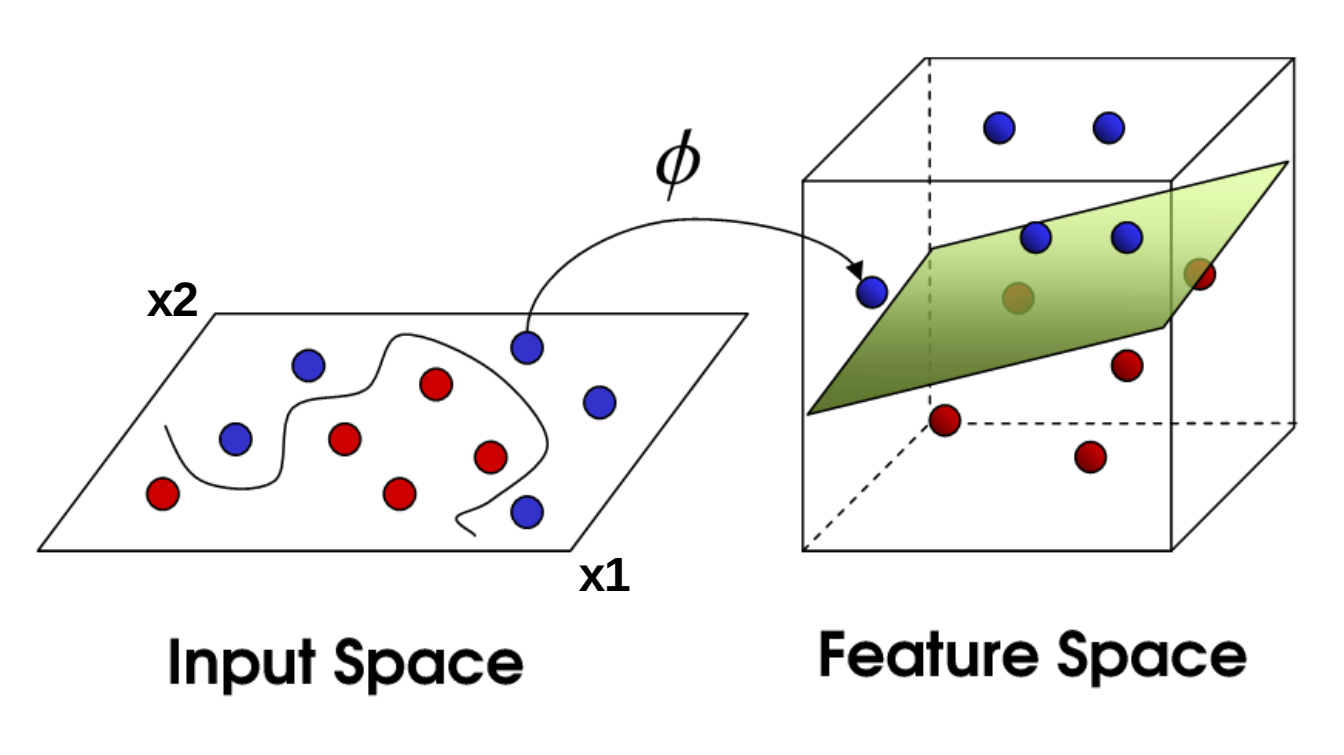




Height Bin	# of Returns
>15 m	0
15-14 m	0
14-13 m	0
12-13 m	0
11-12 m	0
10-11 m	0
9-10 m	12
8-9 m	27
7-8 m	29
6-7 m	8
5-6 m	8
4-5 m	13
3-4 m	7
2-3 m	3
1-2 m	6
0-1 m	55

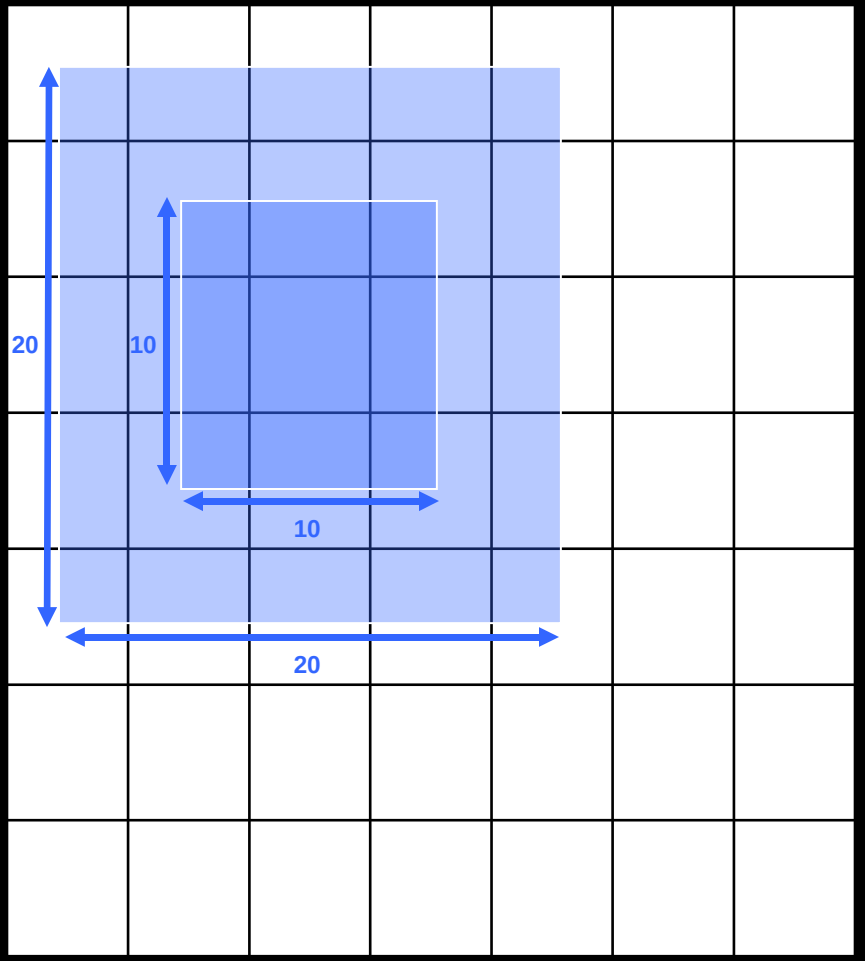
Support Vector Machines (SVMs)

- Used to address the "curse of dimensionality" in the most challenging classification problems



Additional Data Processing

- **Holling (1992):** contagious disturbance processes create pattern at mesoscale
- Used “moving window” to average the number of lidar returns over various distances



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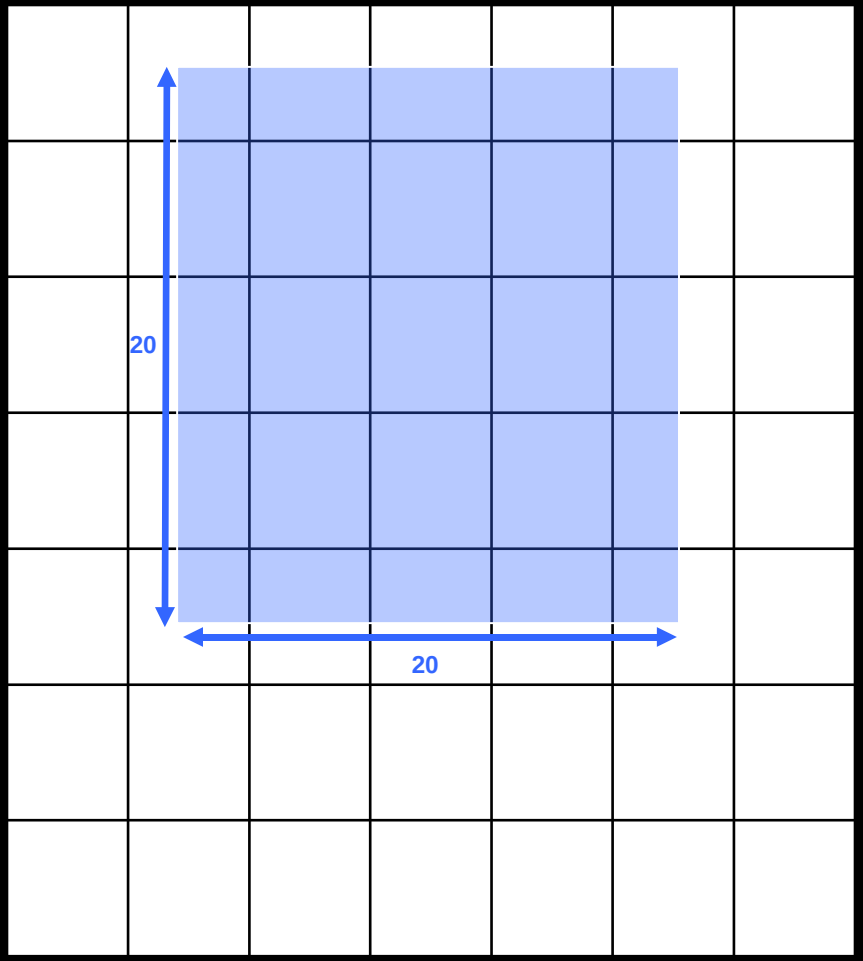


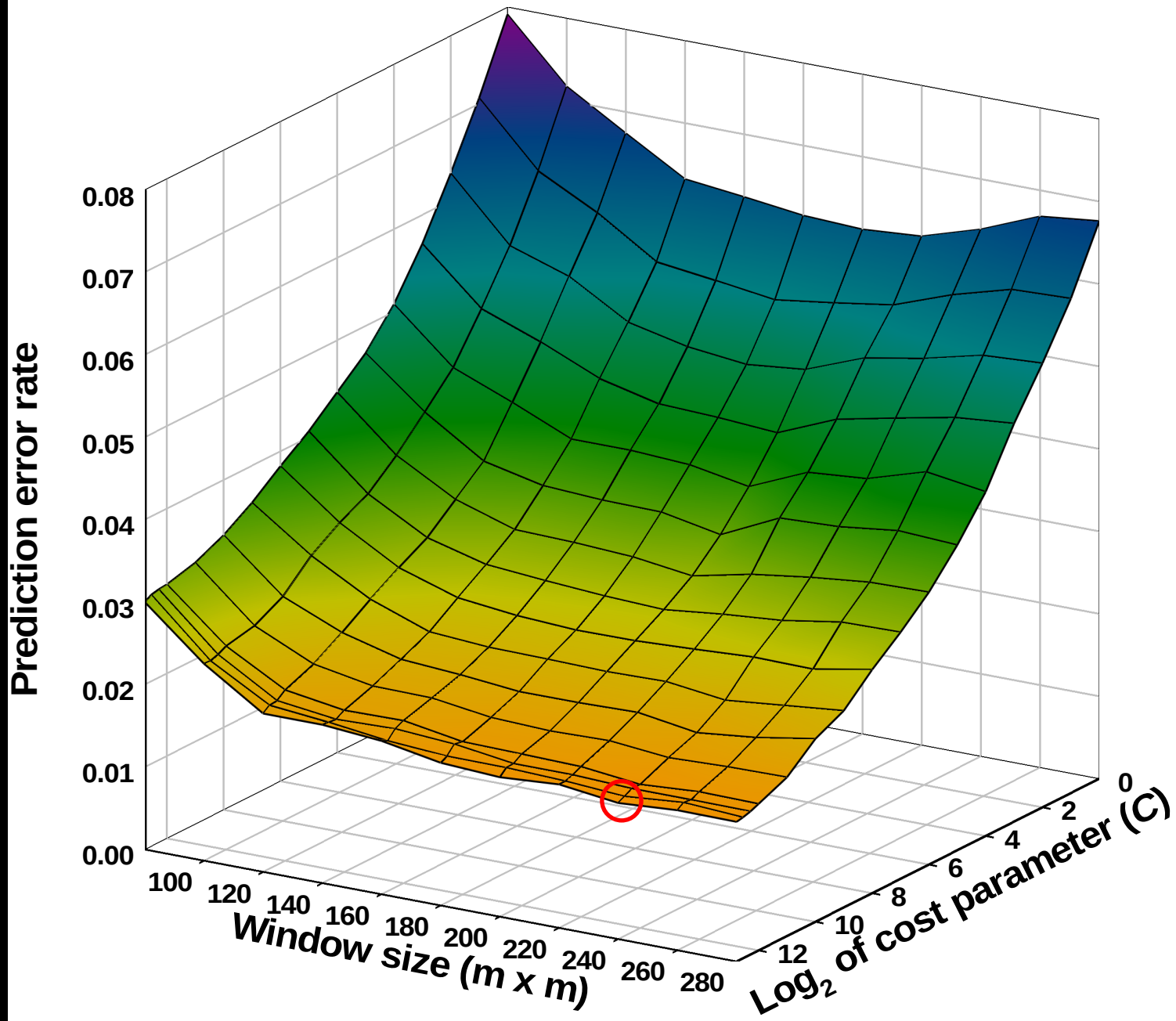
Five-Fold Cross-Validation

- Partition dataset into 5 equal-sized "folds":

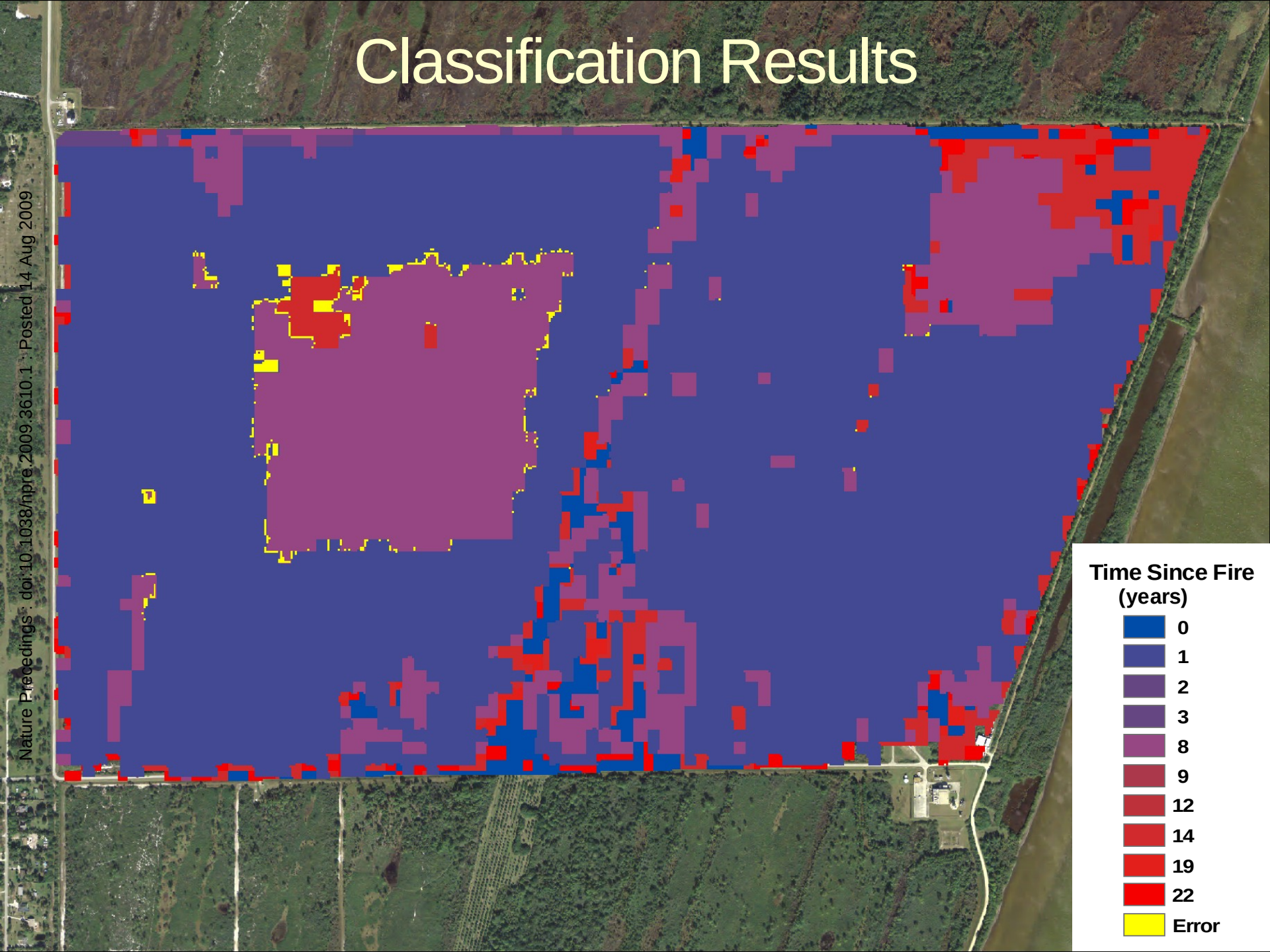
Train	Train	Train	Train	Test
Train	Train	Train	Test	Train
Train	Train	Test	Train	Train
Train	Test	Train	Train	Train
Test	Train	Train	Train	Train

- Average the error rates on the Test data to estimate the prediction error

Support Vector Machine Accuracy



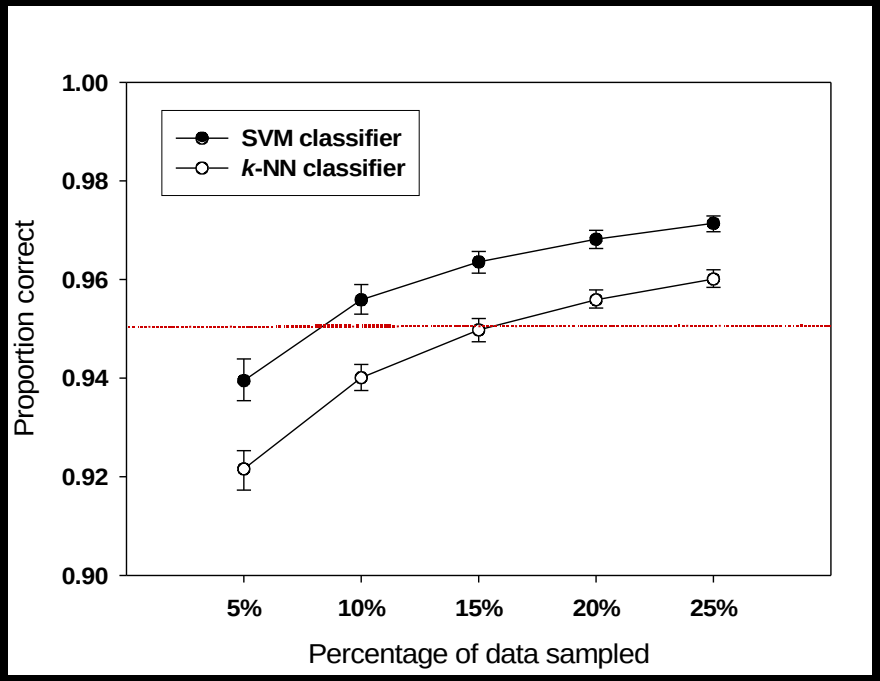
Classification Results

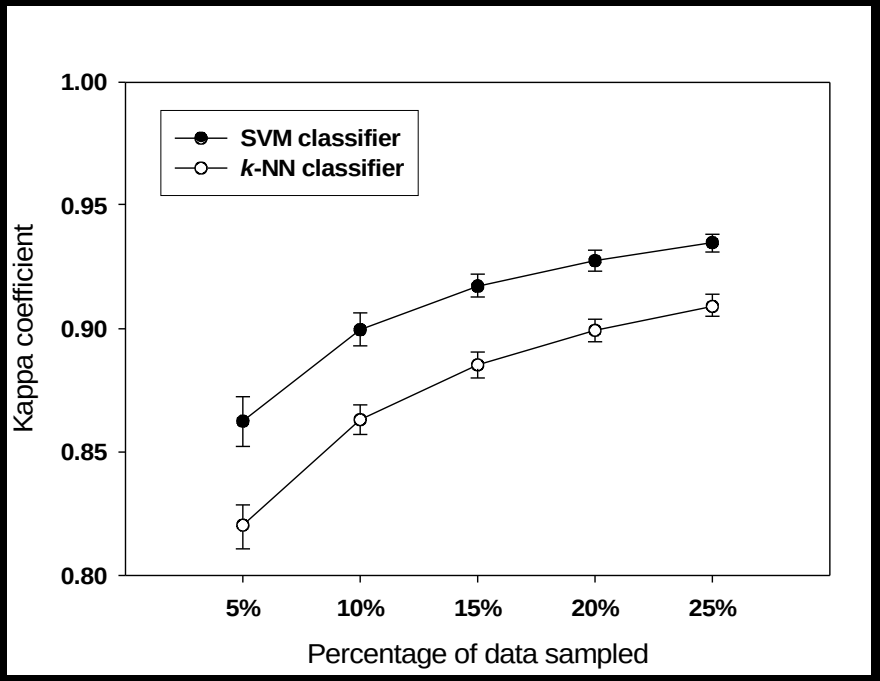


Estimating Size of Training Set

- Generated 1000 stratified random samples representing 5%, 10%, 15%, 20%, and 25% of full dataset
- Trained SVM and k-NN classifiers on each sample and then tested on remaining dataset
- Created 95% confidence intervals for proportion correct and Kappa coefficient

Estimating Size of Training Set



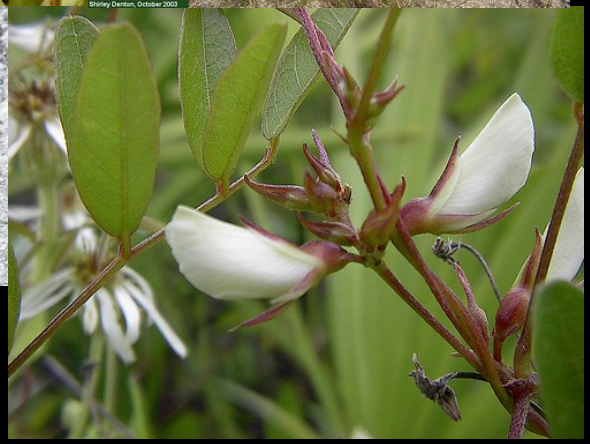


Summary and Conclusions

- As predicted by the Extended Keystone Hypothesis, fire creates distinct 3-D patterns in oak scrub vegetation
- Discrete-return lidar can be used with SVMs to classify these patterns with very high accuracy
- SVMs may require training sets comprising only 10% of study area to achieve >95% accuracy

Management Implications

- Fire is crucial to the health of Florida oak scrub habitat
- Lidar remote sensing may allow rapid, landscape-scale assessment of fire legacies



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