

**UW**

**R**emote  
**S**ensing &  
**G**eospatial  
**A**nalysis  
**L**aboratory

# REMOTE SENSING, LIDAR AND WETLANDS

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# UW-Remote Sensing and Geospatial Analysis Laboratory

<http://depts.washington.edu/rsgal/>

## UW Remote Sensing & Geospatial Analysis Laboratory

The Research Laboratory of Dr. L. M. Moskal at the University of Washington

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Publications
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Understanding high spatiotemporal resolution multidimensional ecosystem process, function, monitoring and applications through geospatial techniques

**UNIVERSITY OF WASHINGTON**

**MY FEATURED NSF PROJECTS**

- Center for Advanced Forestry Systems (CAFS) located at The University of Washington, NSF Award # 0855690
- CNH Collaborative Research: Northern Gulf of Mexico Hypoxia and Land Use in the Watershed: Feedback and Scale Interactions, NSF Award # 1010009

**NEWS & EVENTS**

**SPR Graduate Student Symposium Videos:**

- Object-based Classification of Semi- and Wetlands in Eastern Washington by Meghan Heikaby
- Vegetation Sampling at the Speed of Light by Jeff Richardson

**April 20 CUGOS/ASPRS/UW Geospatial Club Meeting at UW**

**April 12-16 RSGAL @ AAG**

**April 8 ASPRS Tech Exchange @ UW**

**March 3 UW RSGAL Geospatial Canopy Cover Assessment Workshop**

**Feb. 4, 2011 UW Urban Forest Assessment (UFA) Geospatial Portal**

**Oct 16, 2009 Dr. Moskal joins a panel of UDAR experts at SilvLaser2009**

**RSGAL Journal Club meets once a month, we use Mendeley.com to share our journal articles, contact Dr. Moskal to be added to the club's list.**

**RSGAL QUICK LINKS**

- Discussion Board
- Workspace
- ShareSpace
- Project Tracker
- Thesis/Dissertation Tracker
- RSGAL Lab Meeting Minutes
- RSGAL Guidelines
- RSGAL Course Guidelines
- RSGAL on YouTube1 UTube2

Welcome to Dr. L. M. Moskal's Remote Sensing and Geospatial Analysis Laboratory (RSGAL), the remote sensing and geospatial research partner of the Precision Forestry Cooperative in the College of the Environment, School of Forest Resources at the University of Washington. The laboratory was established in 2003 and originally located at Missouri State University (June 2003 - May 2006). It continues to be directed by Dr. L. M. Moskal at the University of Washington since June 2006.

**MISSION**

To provide a research rich environment and exceptional resources that drive the understanding of multiscale dynamics of landscape change through the innovative application of remote sensing & geospatial tools. RSGAL research promotes a transdisciplinary approach for sustainable management solutions to pressing environmental issues.

**CURRENT RESEARCH** more research

RSGAL's research goal is to understand multiscale and multidimensional dynamics of landscape change through the application of remote sensing, GIS and geospatial tools. The lab develops tools necessary to analyze hyper-resolution remotely sensed data by exploiting spatial, temporal and spectral capabilities of the data. RSGAL work focuses on the application of high spatial resolution remote sensing (UDAR, imagery) to investigate vegetation structure, specifically the utilization of leaf area index in heterogeneous canopies. Other RSGAL research themes involve multi resolution and multi sensor data fusion, spatiotemporal object-based image analysis and geovisualization techniques to communicate research results. Moskal's and RSGAL research has been applied to the following themes: ecosystem services and function, biodiversity/biomass, forest inventories, forest health, change analysis, biodiversity, habitat mapping, spatiotemporal wetland assessment, geostatistical analysis of prairie vegetation communities, urban growth and forest fragmentation.

**SELECTED REFEREED PUBLICATIONS** more publications

Richardson J. and L. M. Moskal, accepted 2011. Strengths and Limitations of Assessing Forest Density and Spatial Configuration with Aerial UDAR, Remote Sensing of Environment, Halabisky, M., L. M. Moskal and S. A. Hall, 2011. Object-Based Classification of Semi-And Wetlands, Journal of Applied Remote Sensing, 5(05351), p.13

Vaughn N., L. M. Moskal and E. Tumboli, 2011. Fourier transformation of waveform UDAR for species recognition, Remote Sensing Letters, 2(4): 347-356.

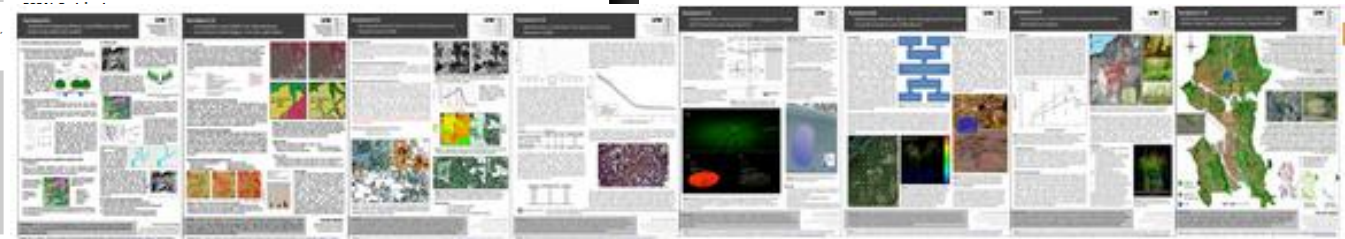
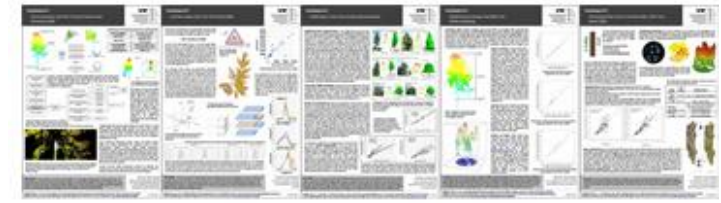
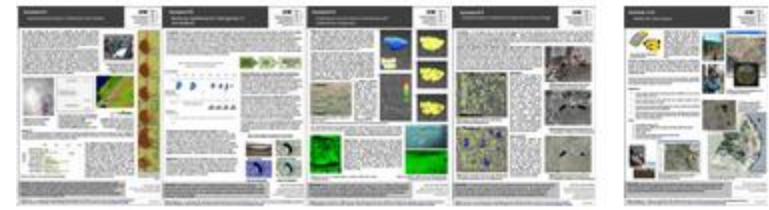
Erdody T. and L. M. Moskal, 2010. Fusion of UDAR and Imagery for Estimating Forest Canopy Fuels, Remote Sensing of Environment, 114(4): 725-737.

Moskal, L. M., T. Erdody, A. Kato, J. Richardson, G. Zheng and D. Briggs, 2009. Aerial and Terrestrial UDAR Applications in Precision Forestry, SilvLaser2009 Conference Proceedings, College Station, TX.

Kato, A., Moskal, L. M., Srinivas, P., Swanson, M., Calhoun, D. and W. Stettle, 2009. Capturing Tree Crown Formation Through Implicit Surface Reconstruction using Airborne UDAR Data, Remote Sensing of Environment, 113(6): 1148-1162.

Zheng G. and L.M. Moskal, 2009. Retrieving Leaf Area Index (LAI) Using Remote Sensing: Theories, Methods and Sensors, Sensors, 9(4):2719-2745.

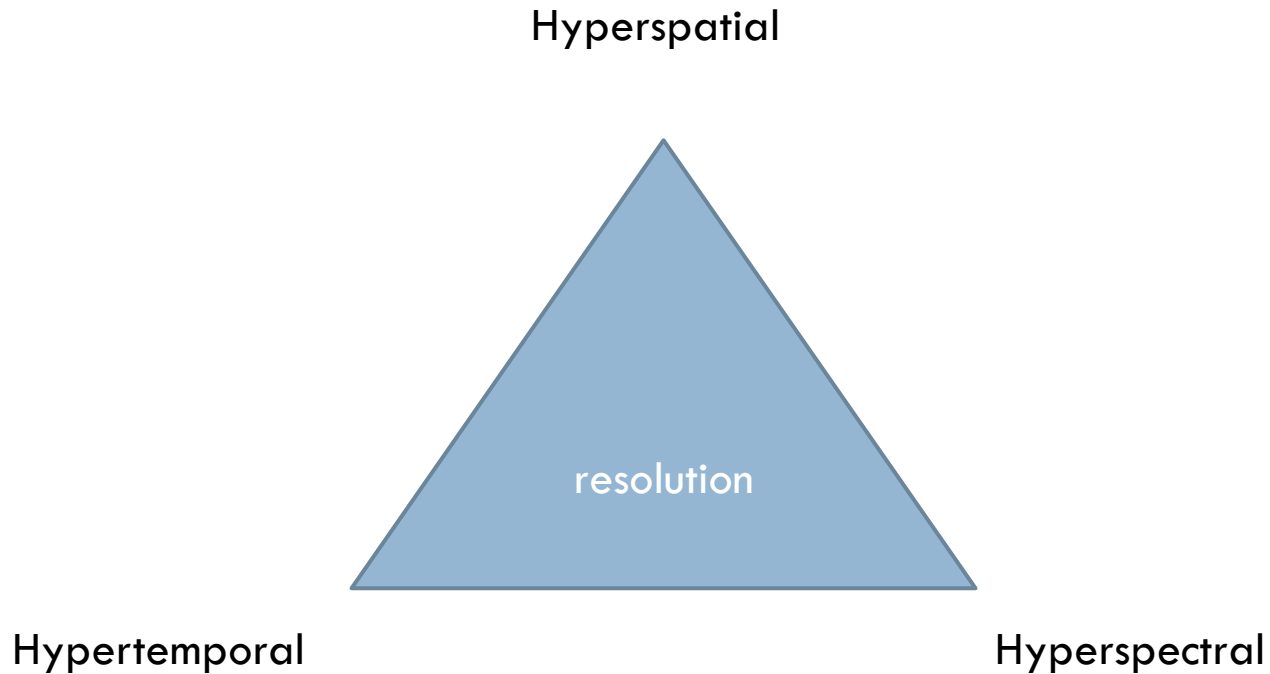
Richardson, J., Moskal, L. M. and S. Kim, 2009. Modeling Approaches to Estimate Effective Leaf Area Index from Aerial Discrete-Return UDAR, Agricultural and Forest Meteorology 149, 1152-1160.



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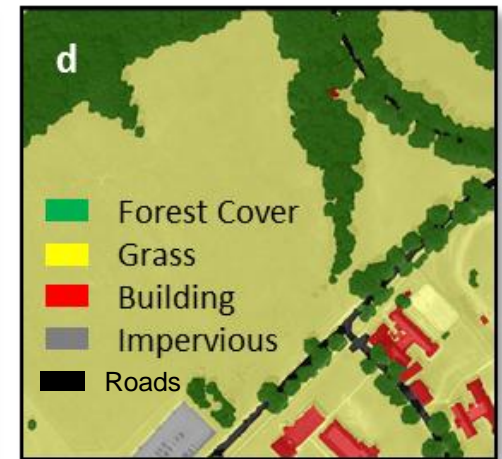
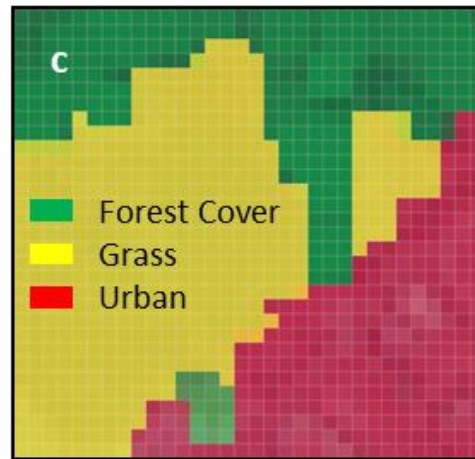
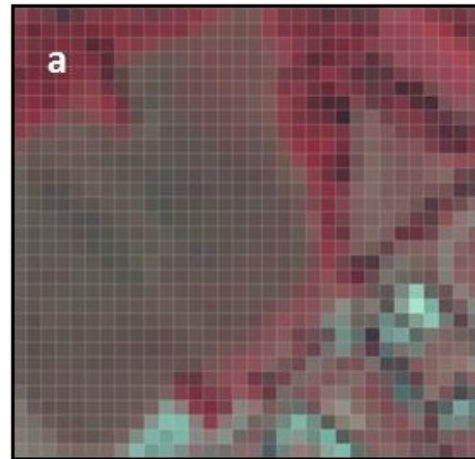
# Hyper-resolution Remote Sensing Technology





# Land Use/Land Cover Mapping - Key Issues

- Coarse Resolution:  
Landsat (a) vs. Hi-res:  
NAIP (b)
- Per-pixel (c) vs. Object  
Based Image Analysis  
(OBIA) methods (d)
- Myint et al. 2011 –  
Per-pixel Accuracy  
67.6% vs. OBIA  
Accuracy 90.4%
- Implications to field  
sampling campaigns











# Remote Sensing Approach



# Remote Sensing Approach



# Remote Sensing Approach

FILE CTRL VIEW TOOLS MENU

Dec 30, 2004



511m

© 2009 Tele Atlas

© 2009 Google™

# Remote Sensing Approach



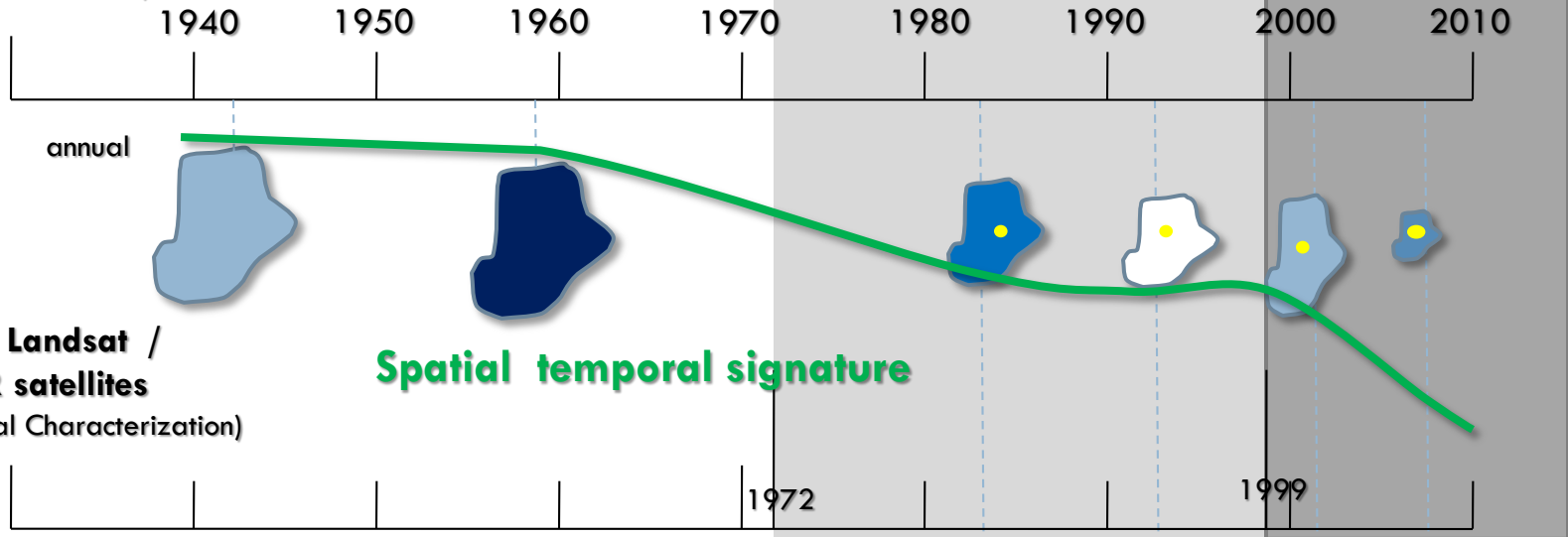
# Remote Sensing Approach



# Monitoring the spatiotemporal heterogeneity of arid wetlands: A three-tiered approach

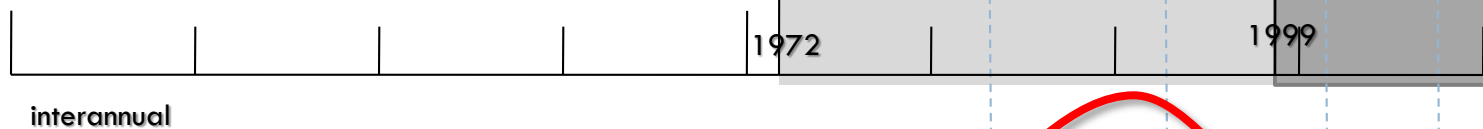
## Aerial Photographs

(Feature Extraction)



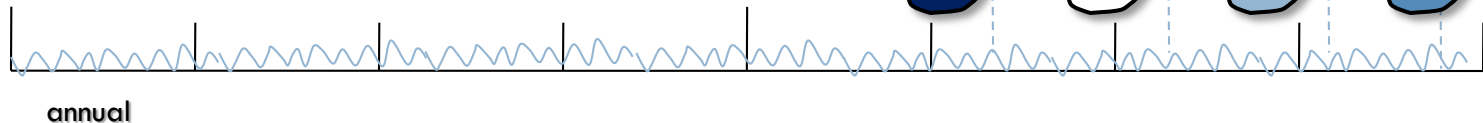
## NASA Landsat / ASTER satellites

(Spectral Characterization)



## Spectral temporal signature

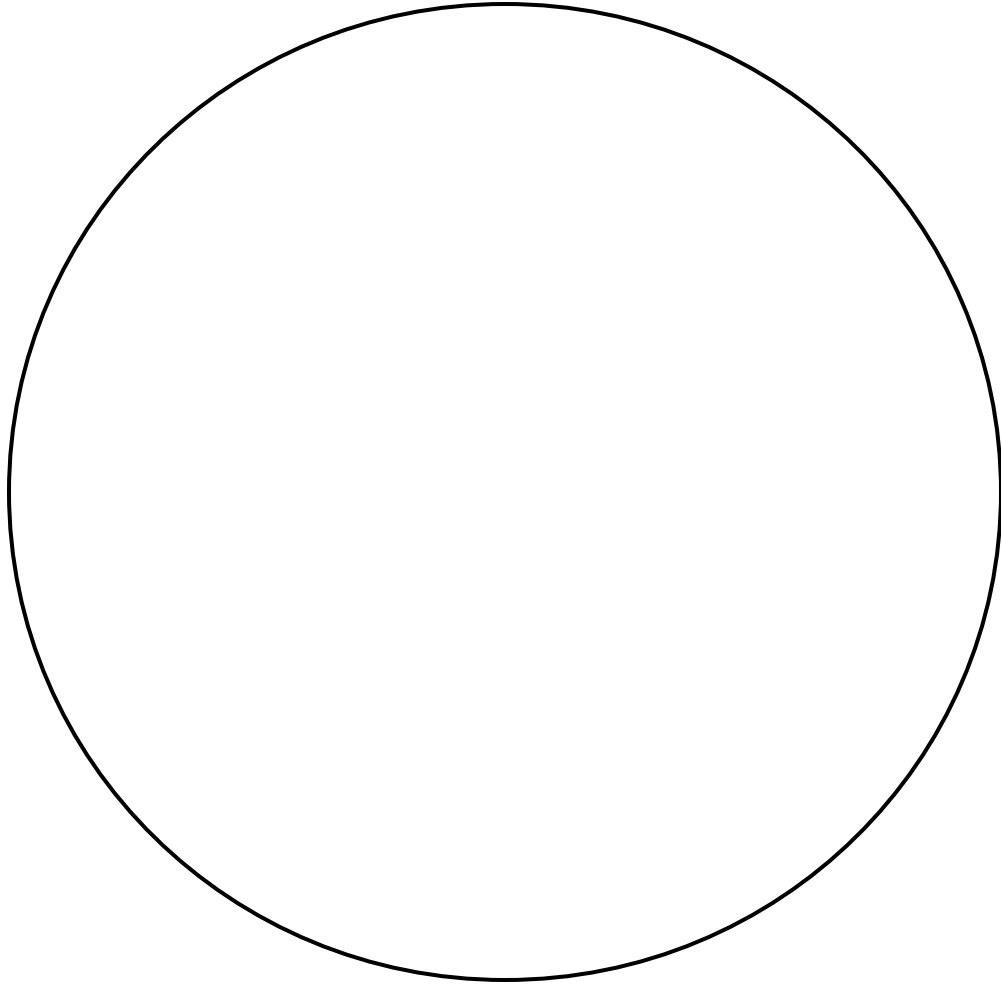
## Temperature / Precipitation data



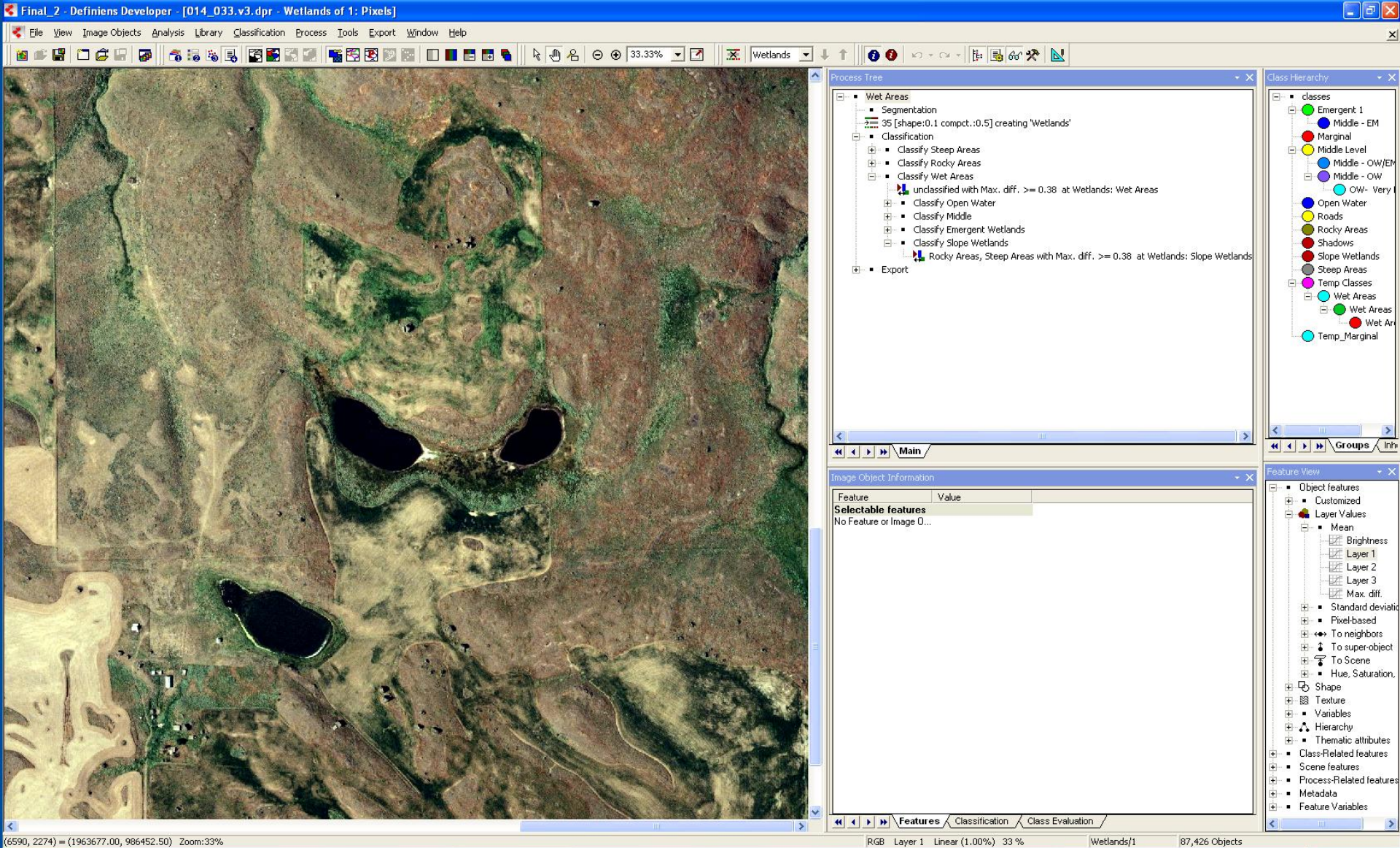
## **PHASE 1**

# **Object Based Image Analysis (OBIA)**

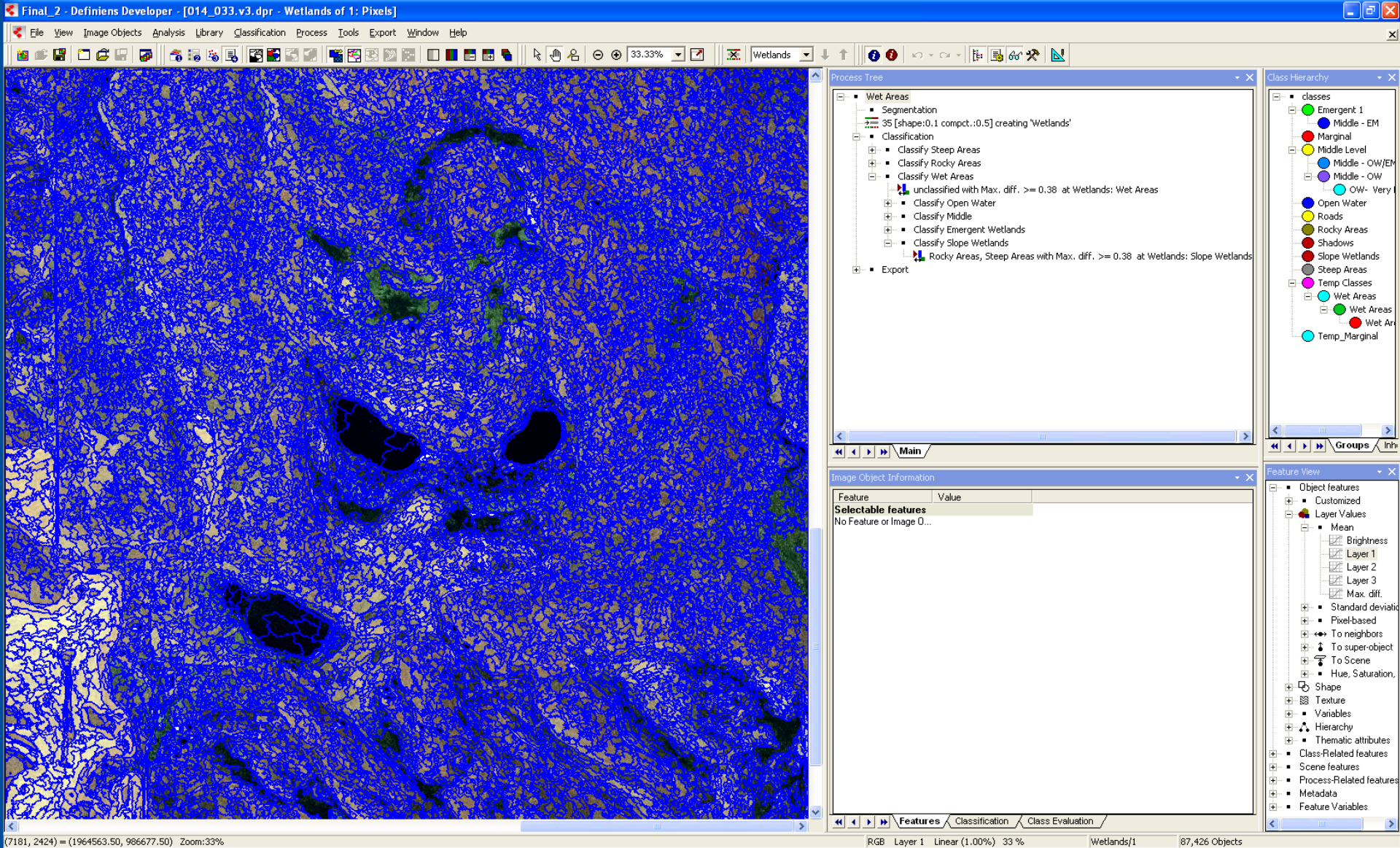
- **This object based image classification method is fundamentally different from per-pixel-classifier approach because it utilized the spatial association and contextual information associated with the object (class) of interest**
- **Image analyst training and skills make this method a powerful new analysis tool for high spatial resolution data**



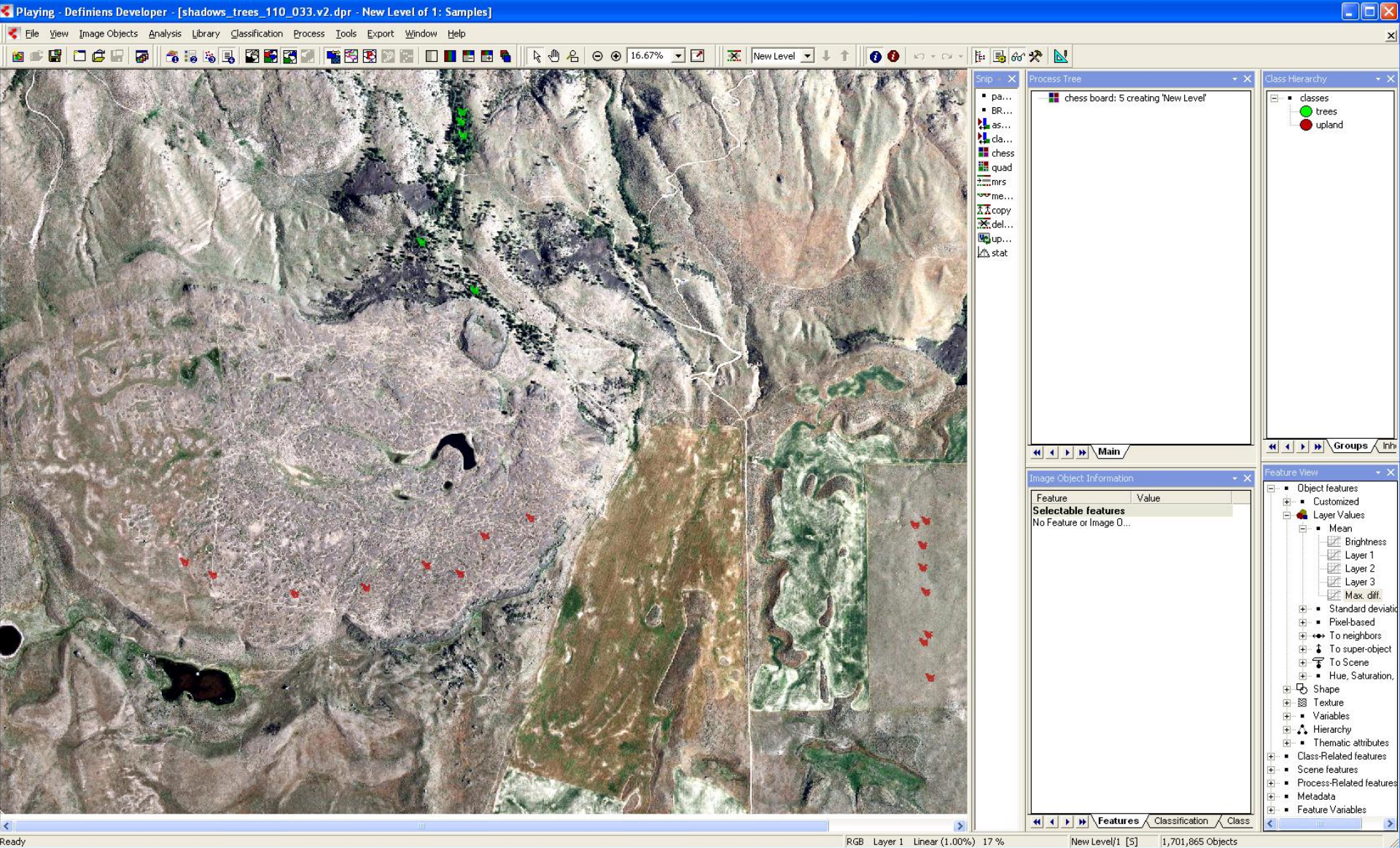




Get data, pre-process, georectify...



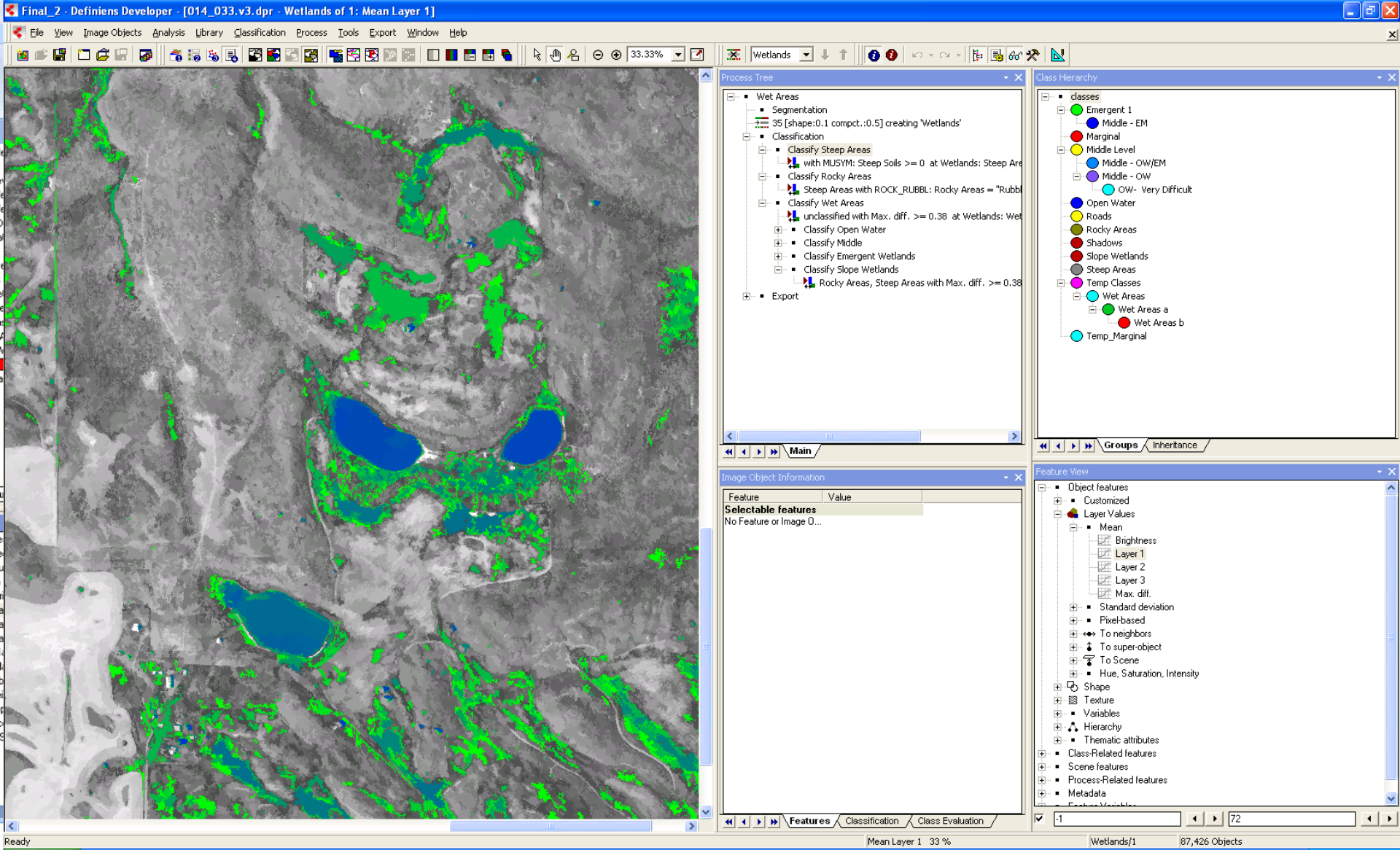
Segmentation...



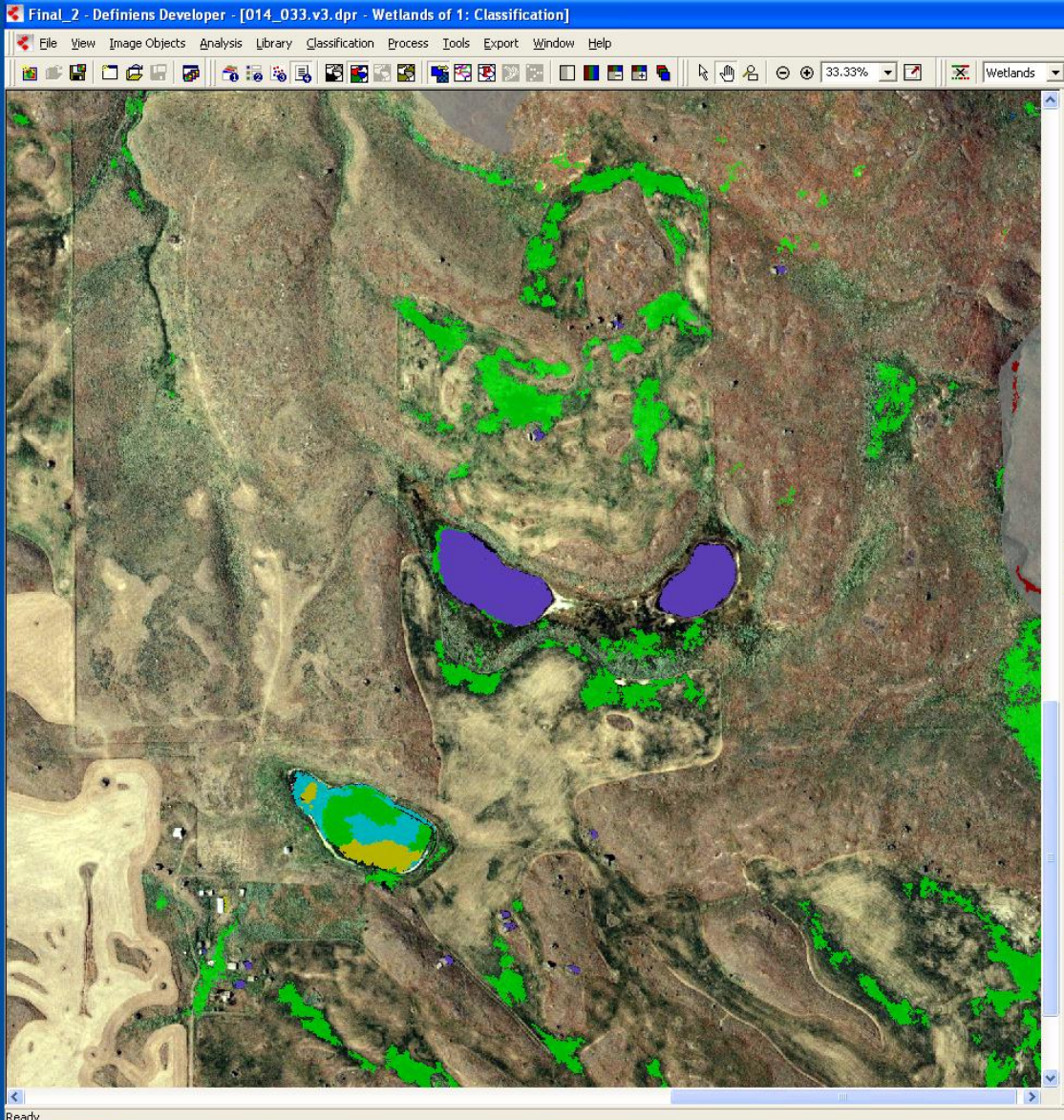
Algorithm training...



Optim



Thresholding...

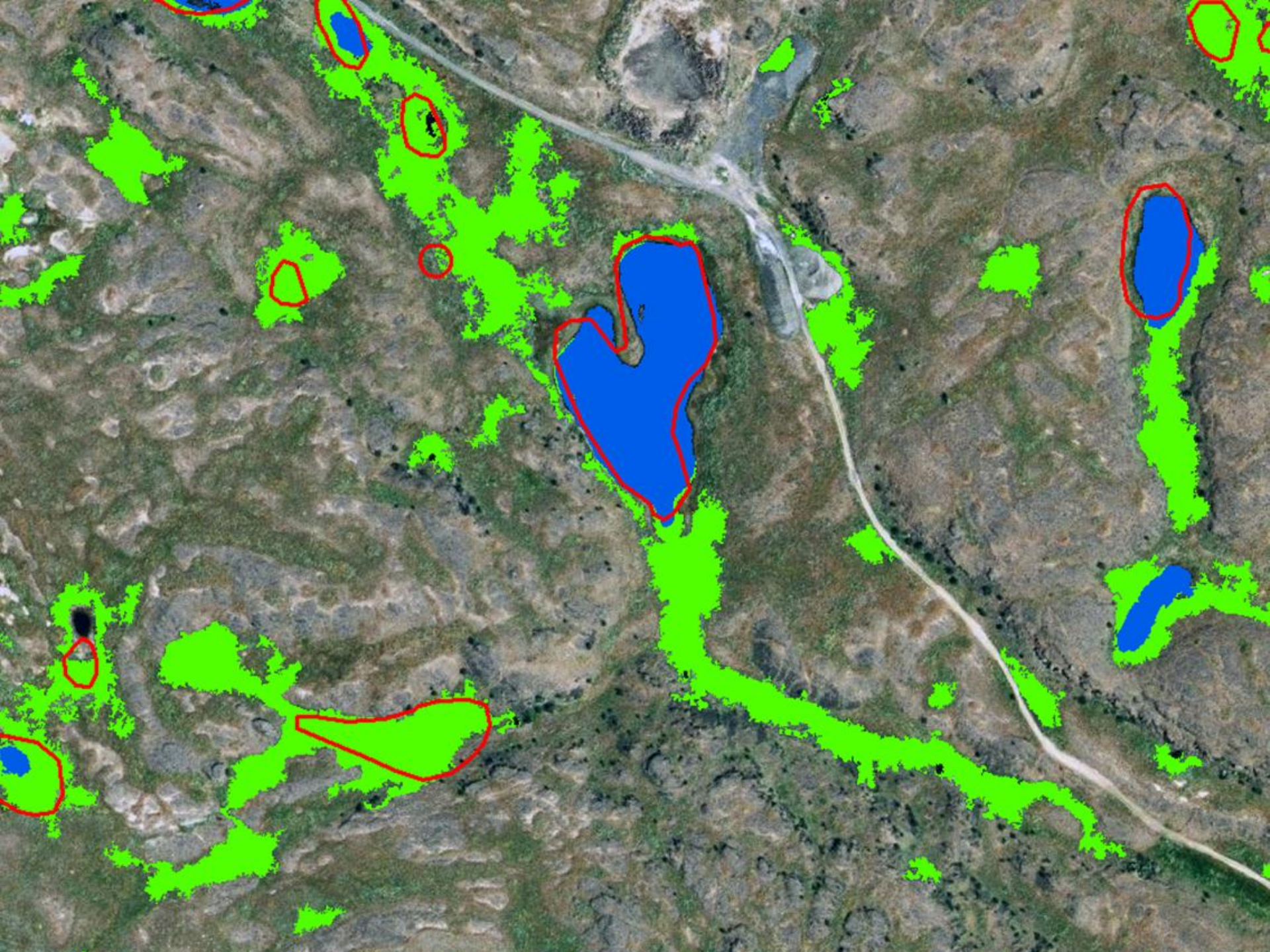


### Class Hierarchy

- [-] classes
  - [-] Emergent 1
    - Middle - EM
    - Marginal
  - [-] Middle Level
    - Middle - OW/EM
    - [-] Middle - OW
      - OW- Very Difficult
  - Open Water
  - Roads
  - Rocky Areas
  - Shadows
  - Slope Wetlands
  - Steep Areas
  - [+] Temp Classes
    - Temp\_Marginal

Navigation: << < > >> Groups Inheritance

Final Hierarchical Classification...

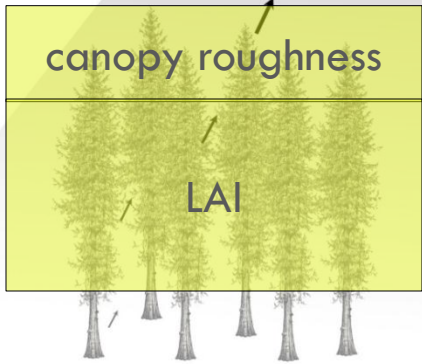


# LiDAR



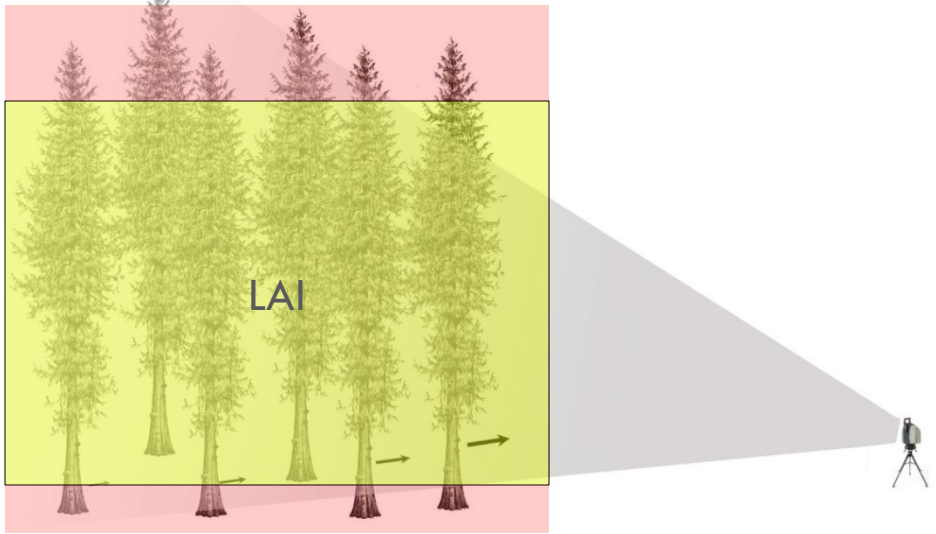
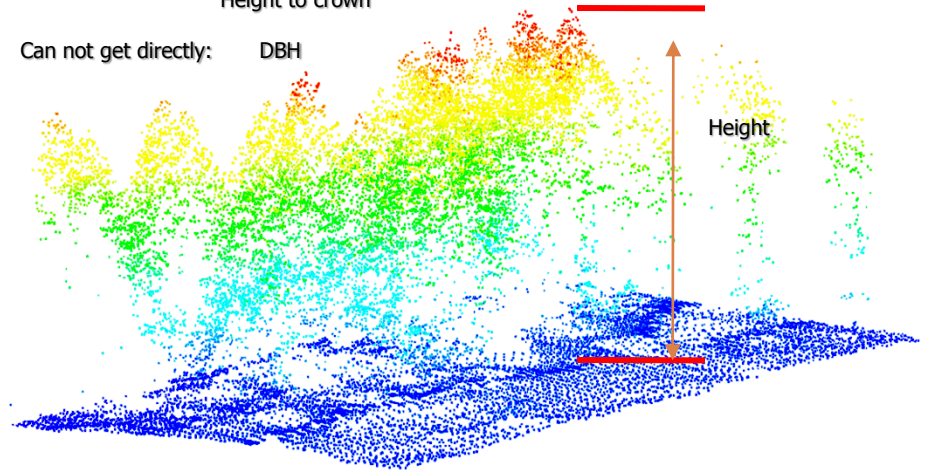


Airborne LiDAR

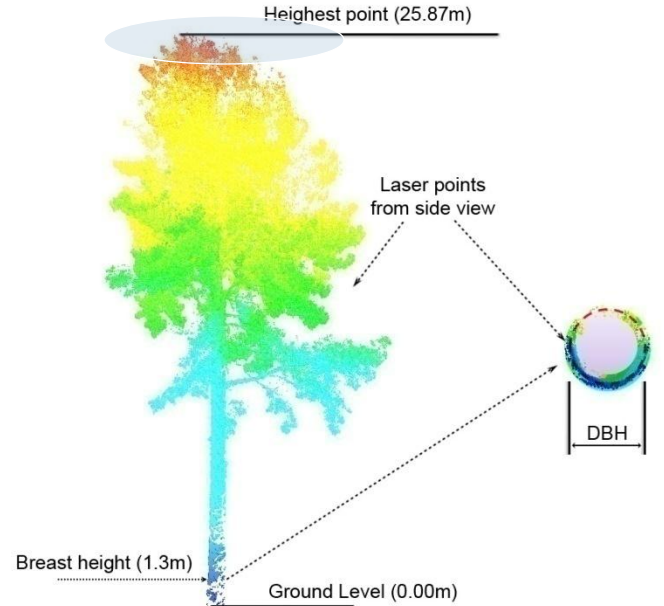


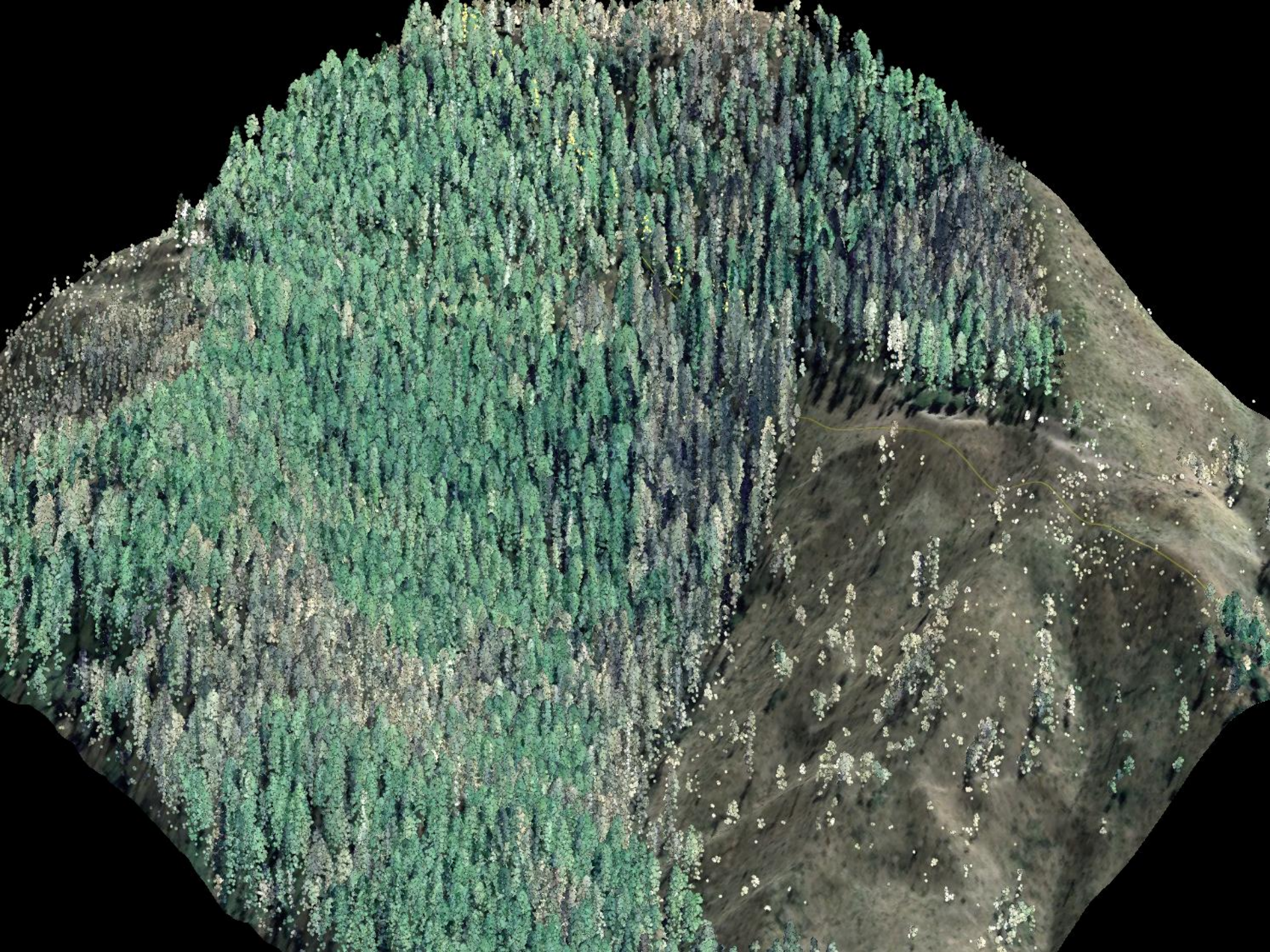
- Easy to get: Stem location, Height, Density
- Harder to get: Species, Crown diameter, Height to crown

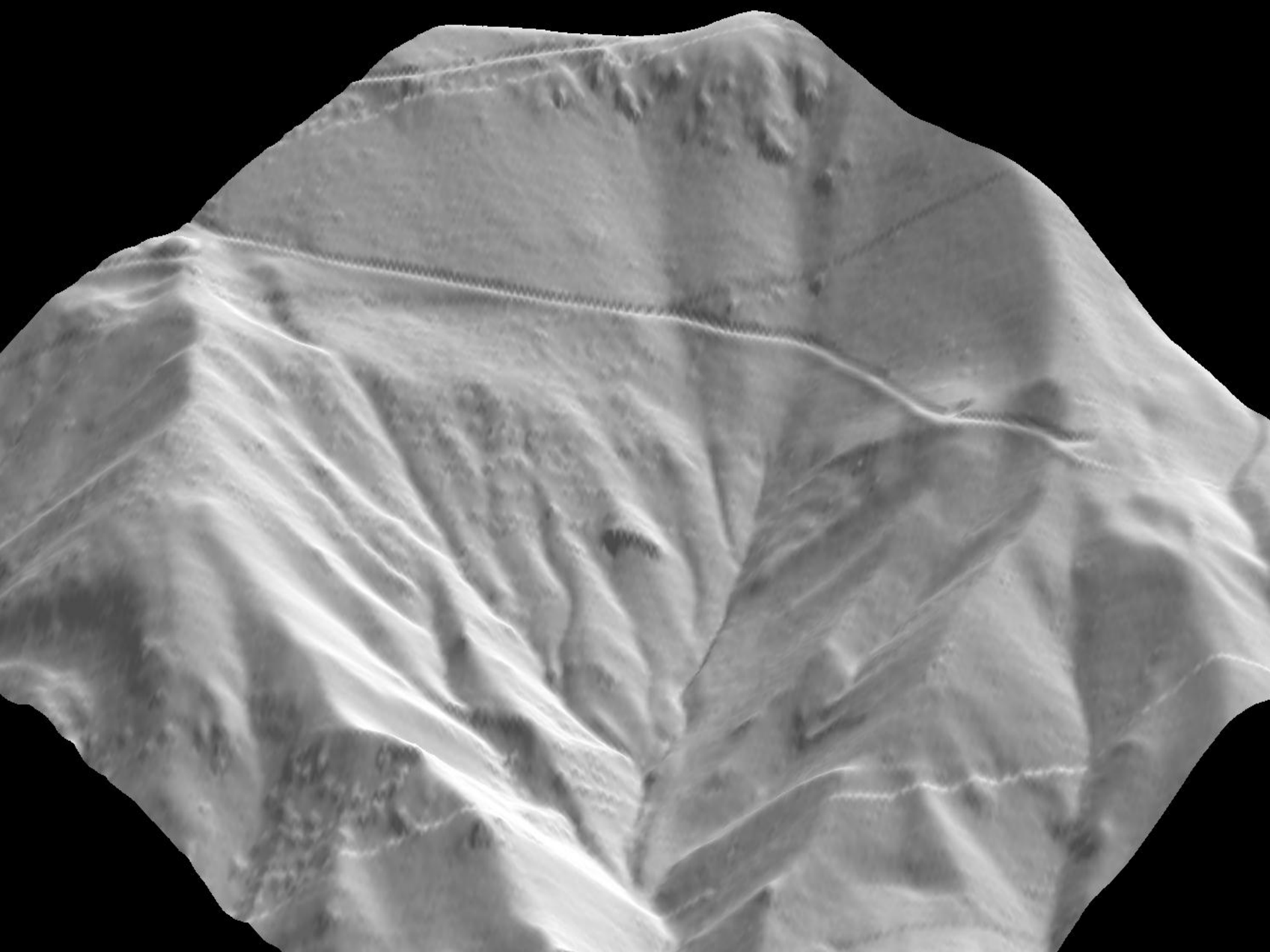
Can not get directly: DBH



Ground-based LiDAR



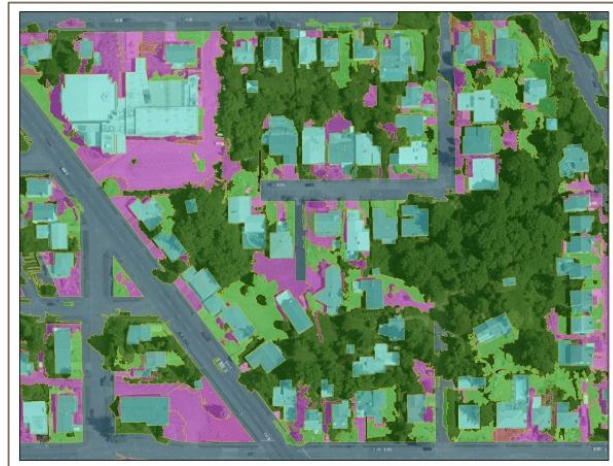




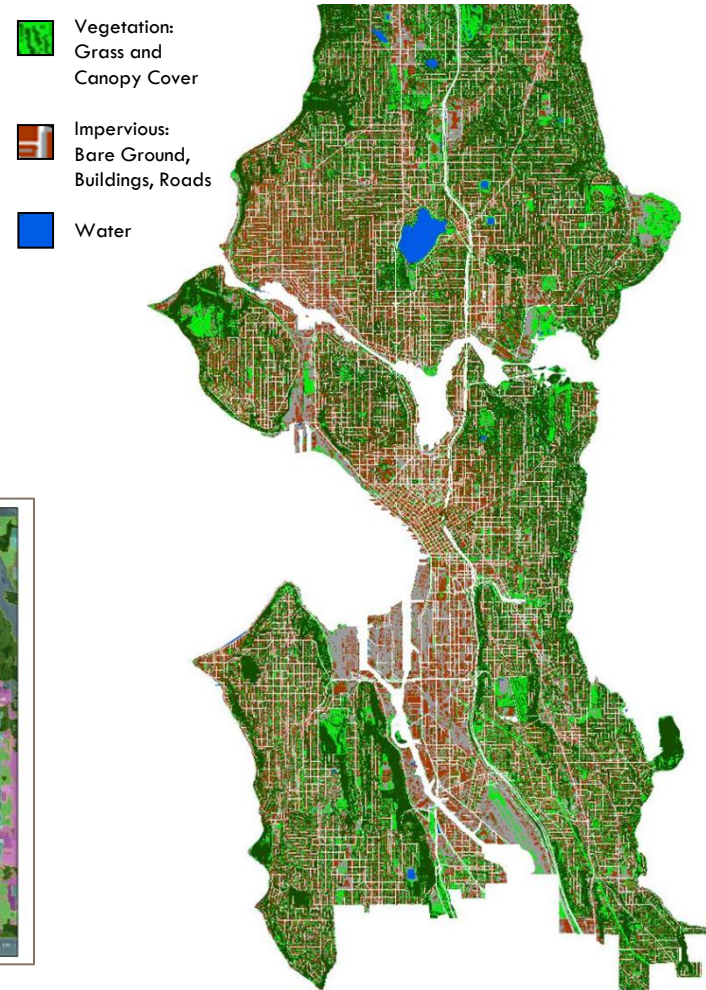
# Aerial LiDAR and Imagery for LULC



2001 NLCD Canopy  
(30m) = 28.5% canopy

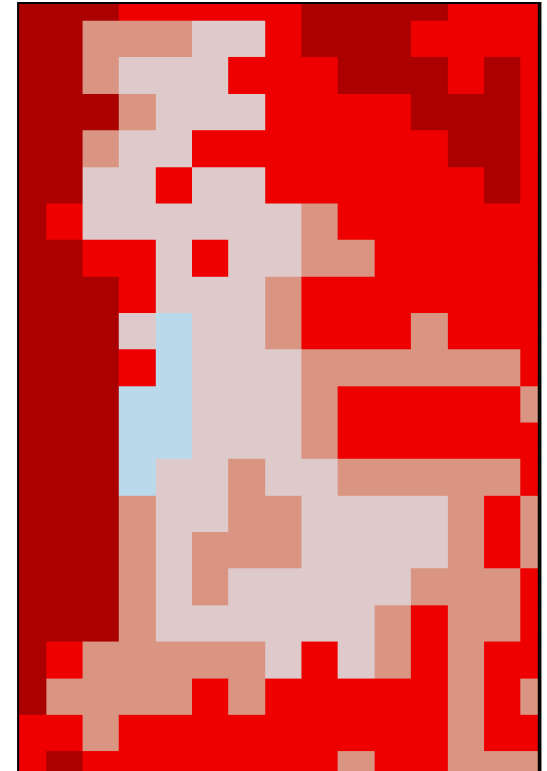
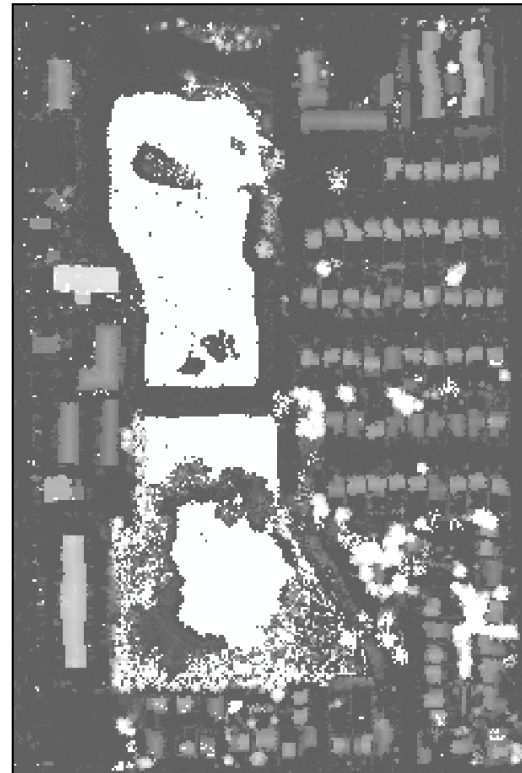


2009 RSGAL LULC (1m)  
25.7% +/- 1.5 canopy



2009 NAIP and LiDAR Seattle LULC

# What about forested wetlands?



Further research funded through the USDA McIntire-Stennis will commence in Fall 2011  
**Integrating LiDAR and Imagery for Mapping Forested Wetlands: an Object Based Approach**

# Simplified LiDAR Based Thermal Loading Model



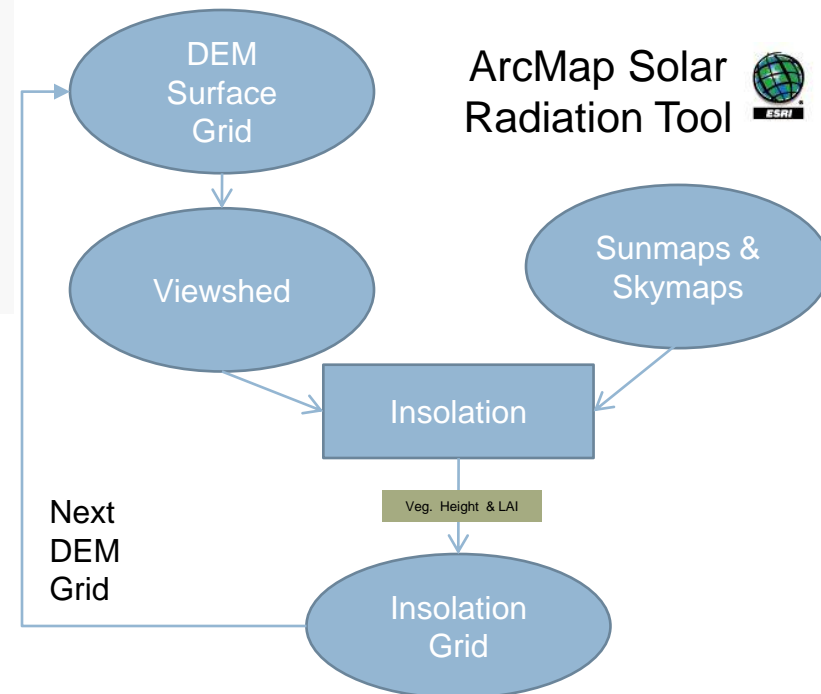
Schematic for obtaining solar energy attenuation from LiDAR. The LiDAR-based terrain model is used in conjunction with canopy density metrics to model solar conditions for 365 days out of the year. The 365 models are combined to produce a thermal loading potential surface. The same technique can be applied on spatial explicit watershed coverage provided by aerial LiDAR and to calibration sites from terrestrial LiDAR.

Source: Moskal and Park 2010

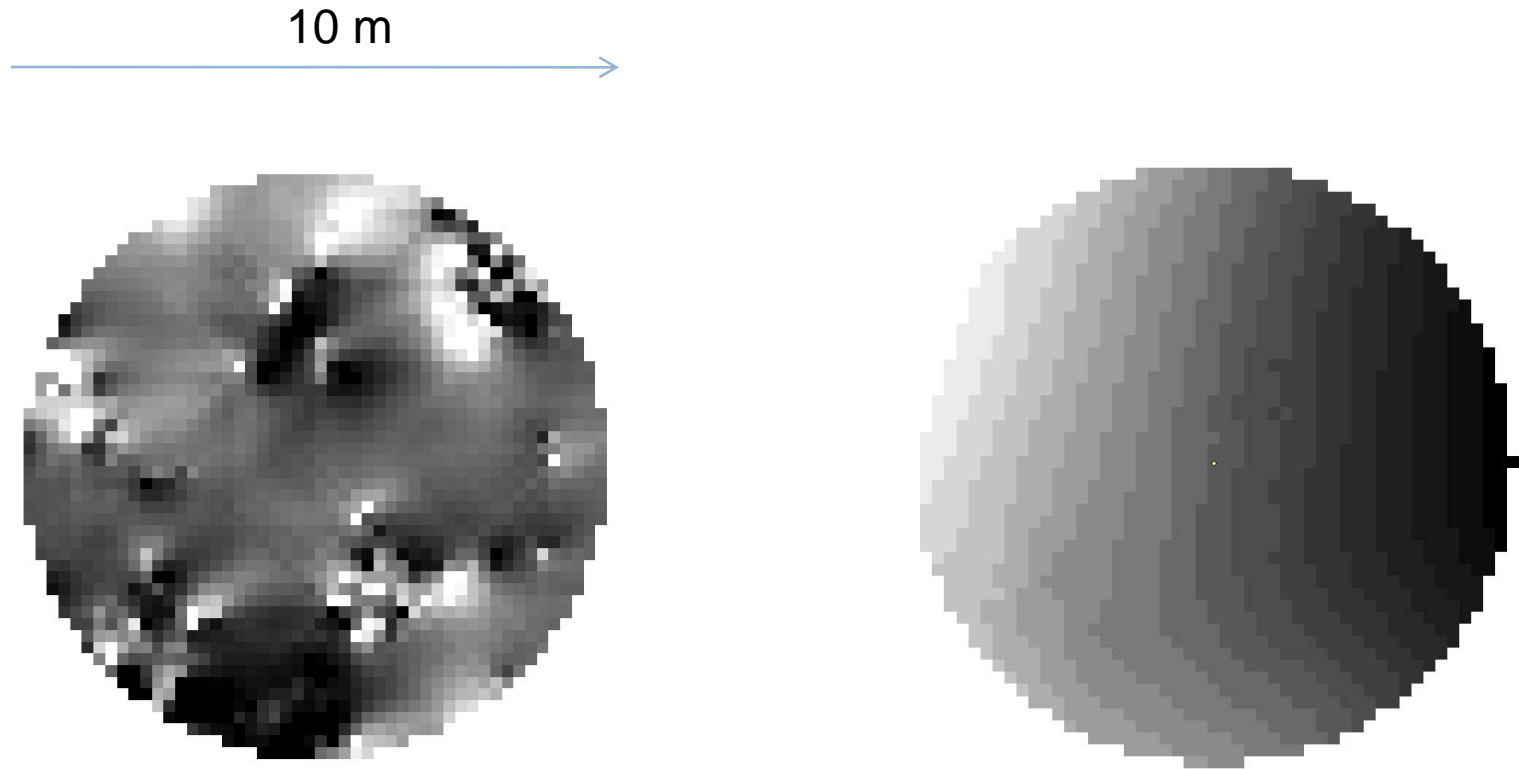
## Solar Radiation Model Parameters:

- LiDAR topographic shading
- LiDAR aspect
- LiDAR Vegetation height/canopy density (LAI)
- geographic location (latitude)
- resolution (data dependent)

Model output (watt/m<sup>2</sup>) is spatially continuous but can be buffered for streams and other features



# Ground vs. Aerial DEM Surface



USGS DEMs will only have one value for the whole plot

# Ground vs. Aerial Solar Radiation

