

Calibrating Forest Remote Sensing with LiDAR

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Supported by NASA Fellowship, City of Seattle, The Nature Conservancy, King County, WA

Today's Talk



Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse



Interpretation and topographic compensation of conifer canopy self-shadowing
Van R. Kane ^{a,*}, Alan R. Gillespie ^b, Robert McGaughey ^c, James A. Lutz ^a, Kevin Ceder ^a, Jerry F. Franklin ^a

Examining conifer canopy structural complexity across forest ages and elevations with LiDAR data

Van R. Kane, Jonathan D. Bakker, Robert J. McGaughey, James A. Lutz, Rolf Gersonde, and Jerry F. Franklin

Abstract: LiDAR measurements of canopy structure can be used to classify forest stands into structural stages to study

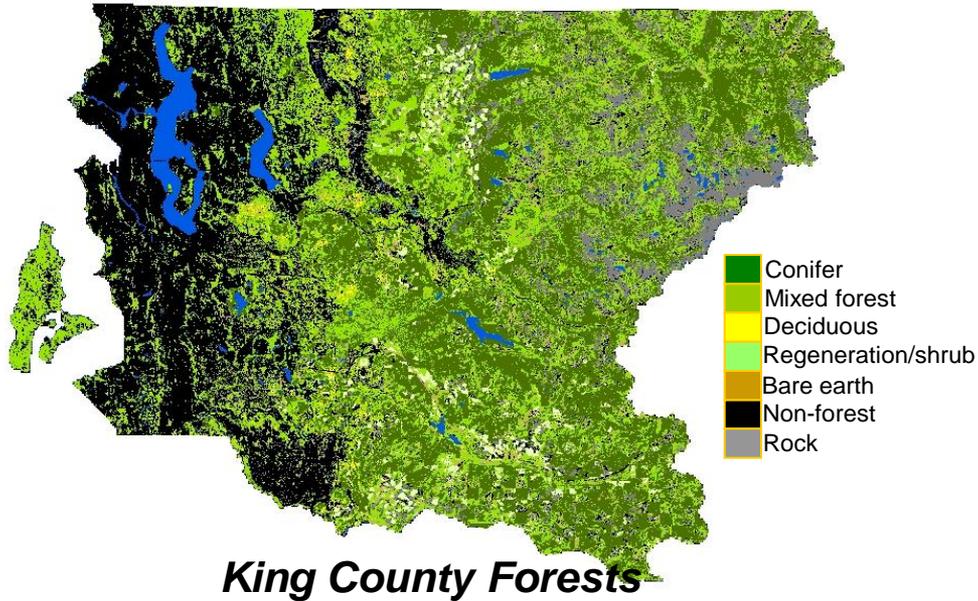
Comparisons between field- and LiDAR-based measures of stand structural complexity

Van R. Kane, Robert J. McGaughey, Jonathan D. Bakker, Rolf Gersonde, James A. Lutz, and Jerry F. Franklin

Abstract: Forest structure, as measured by the physical arrangement of trees and their crowns, is a fundamental attribute

Key results from three published papers and two in advanced preparation

Research Motivation



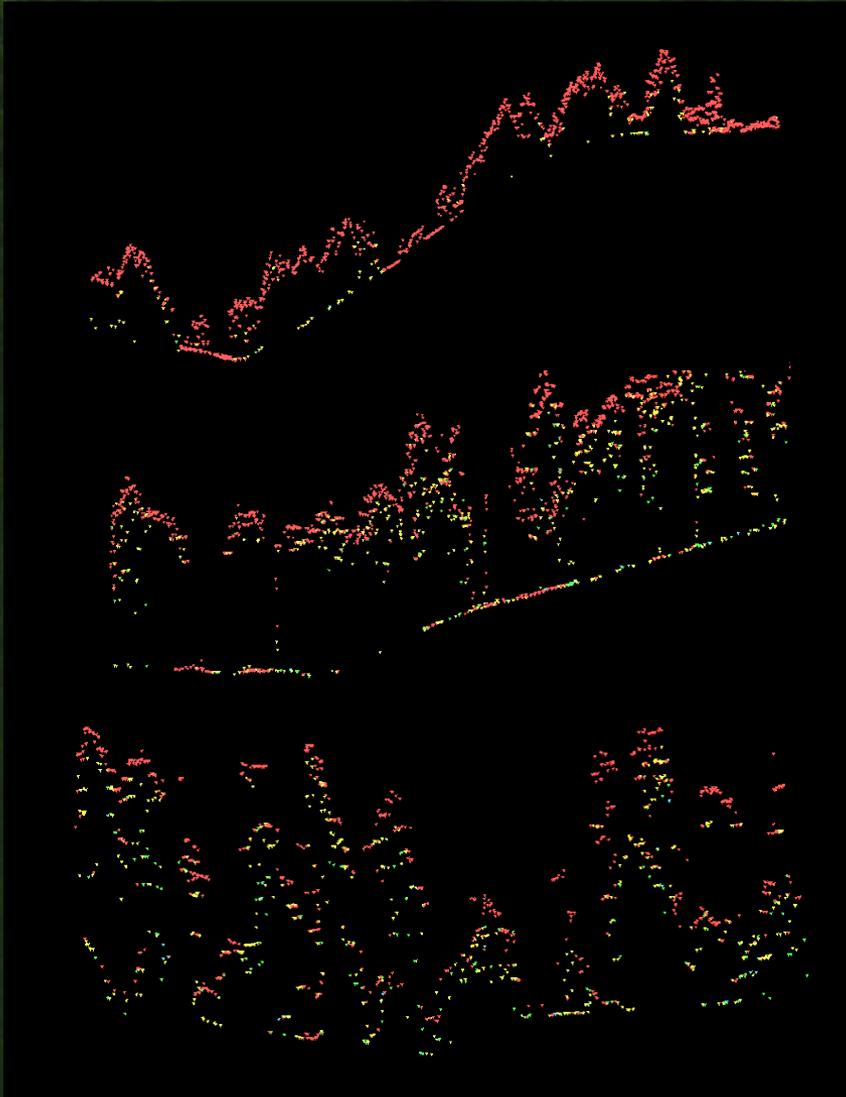
- If you have forest structural and compositional complexity, they* will come, even in young, 2nd growth forests

*Rich(er) communities of critters, fungi, and plants

- Are there significant amounts of complex 2nd growth forests?

King County, Washington state

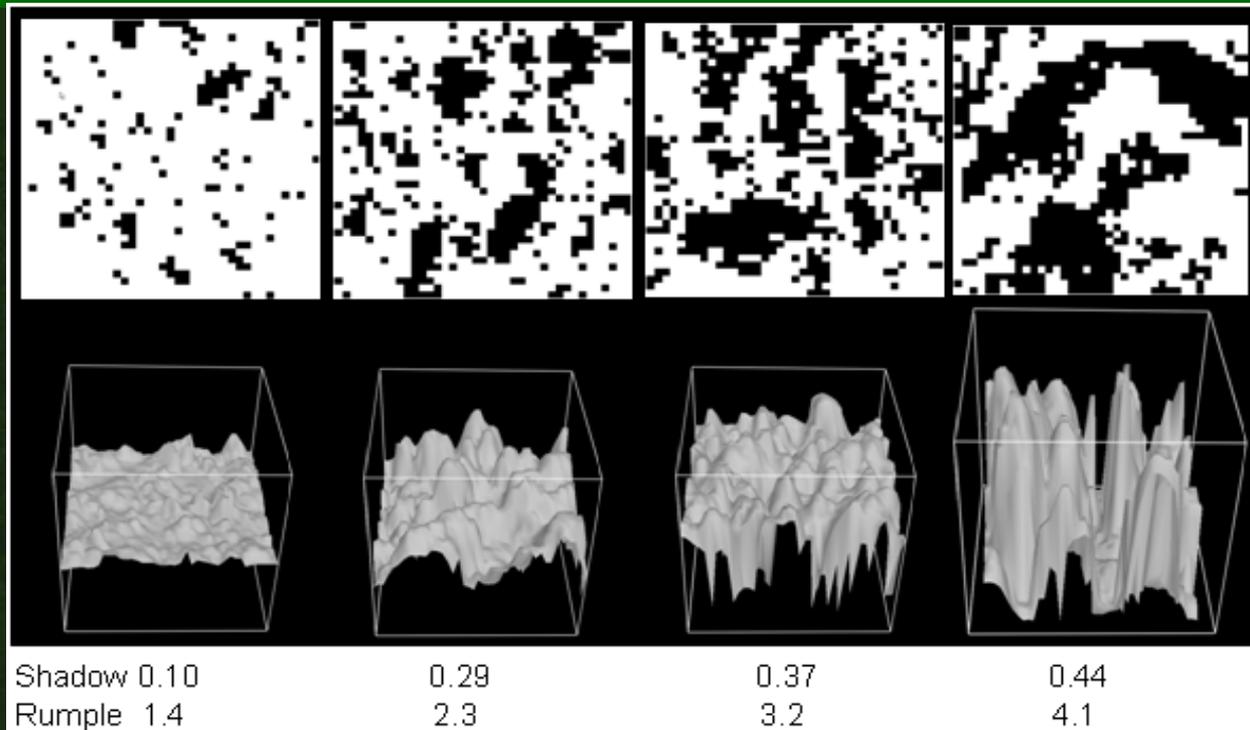
LiDAR to Interpret Satellite Images



*First step,
calibrate satellite
remote sensing
with airborne
LiDAR data*



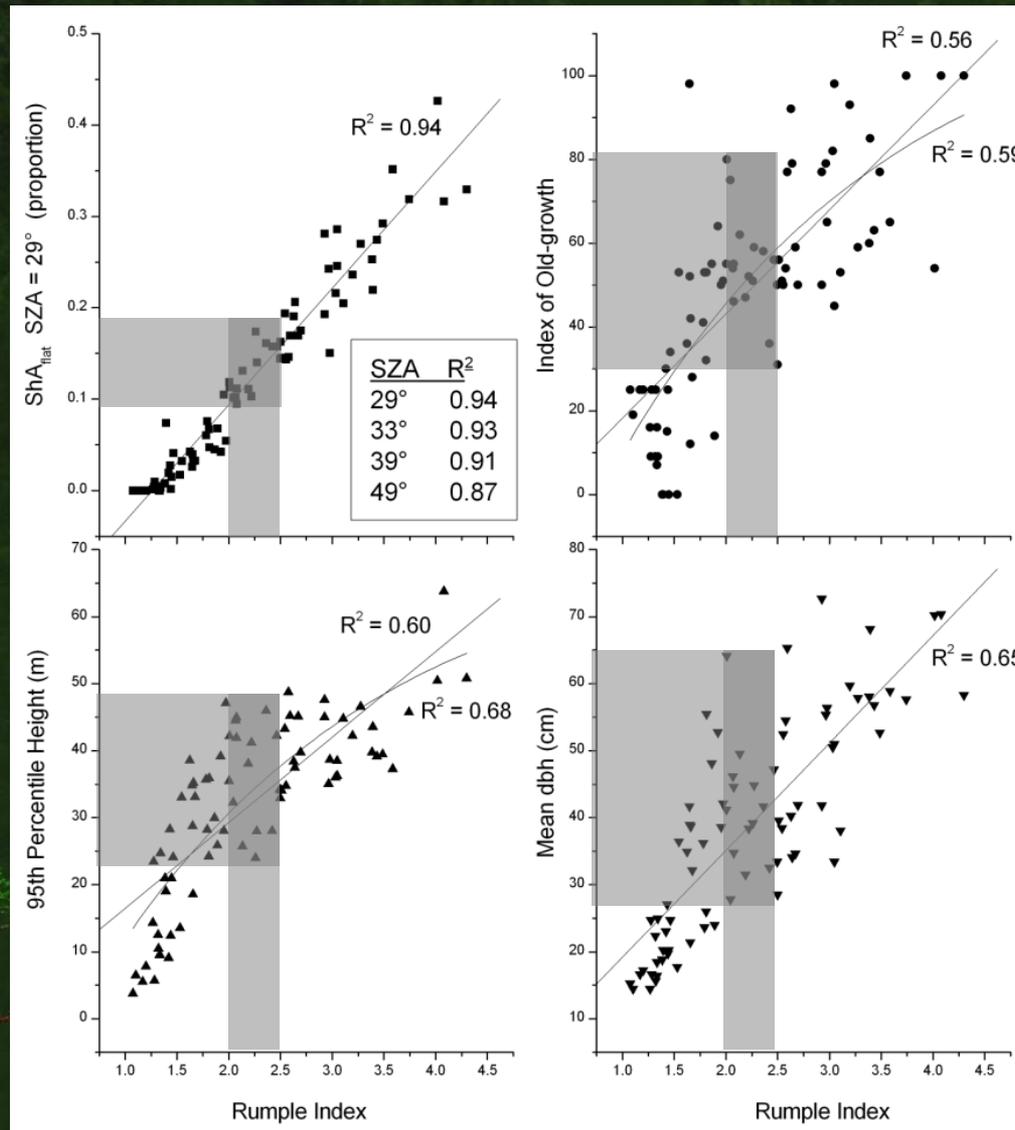
Measuring Structural Complexity



Illumination is for a solar zenith angle of 33° on flat terrain. Canopies range in age from 26 yr (left) to 600 yr (right). Each ground area is 60 x 60 m.

**Canopy self shadowing principle method
for assessing structural complexity**

Rumple as Stand Structure Predictor



Adaptive Shade Correction (ASC)

- ◆ *Topographic correction using both illumination geometry and measured canopy self shadowing*
- ◆ *Coefficients determined from modeling self shadowing of LiDAR canopy surface models*

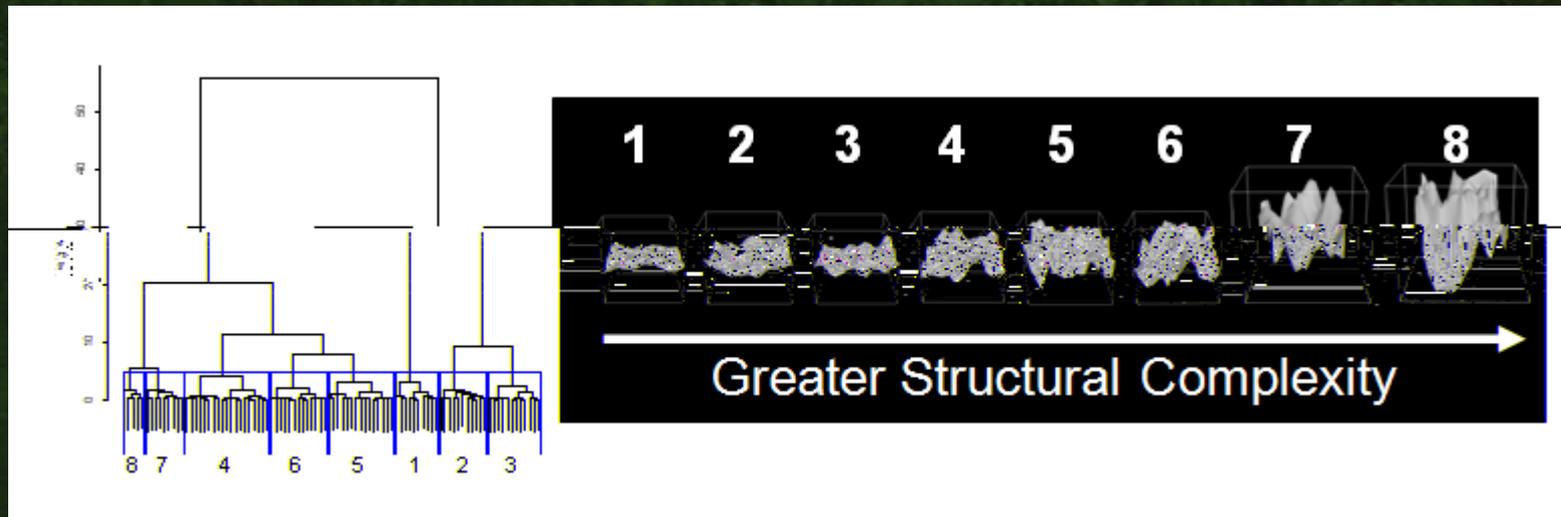
$$ShA_n = b_0 + b_1 ShA + b_2 \left(\frac{\cos \alpha \cos \theta}{\cos i} \right)$$

ShA_n Shaded canopy area (proportion)
 α Slope (degrees)
 θ Solar Zenith Angle (degrees)
 i Incidence angle (degrees)

Correction method	Adjusted R²*
ASC	0.83-0.94
SCS+C (Soenen et al. 2005)	0.36-0.73
SCS (Gu and Gillespie 1988)	0.0-0.14

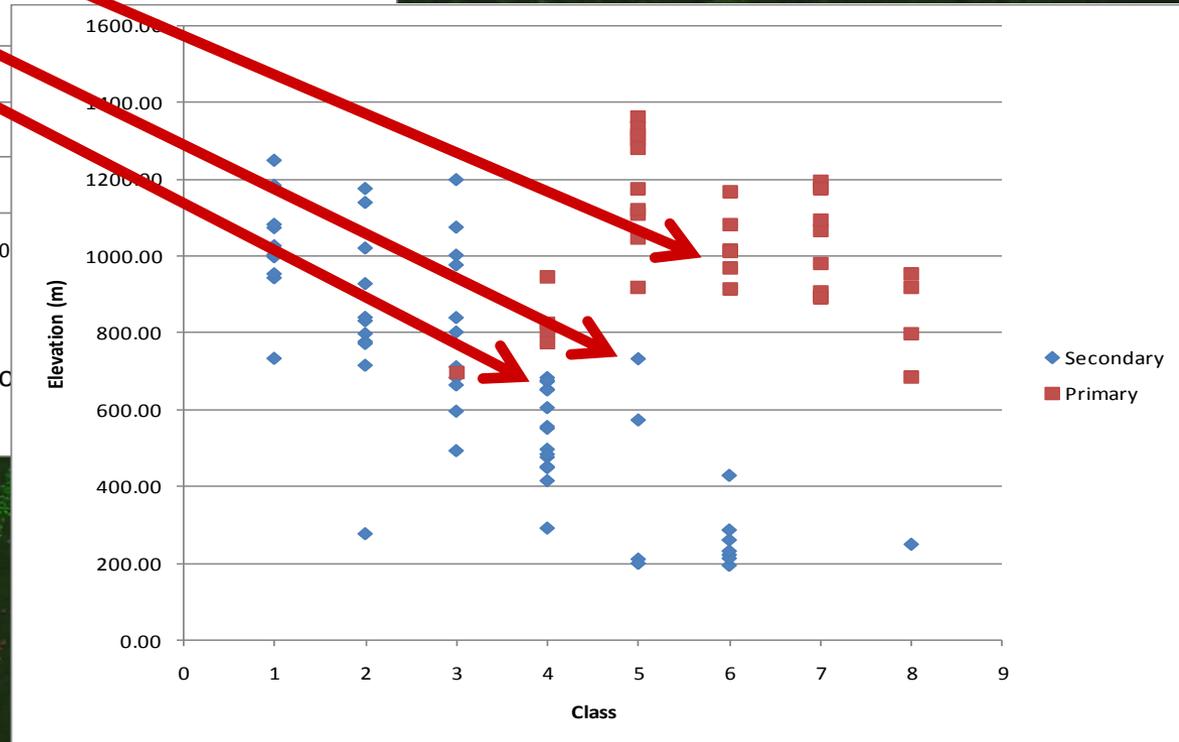
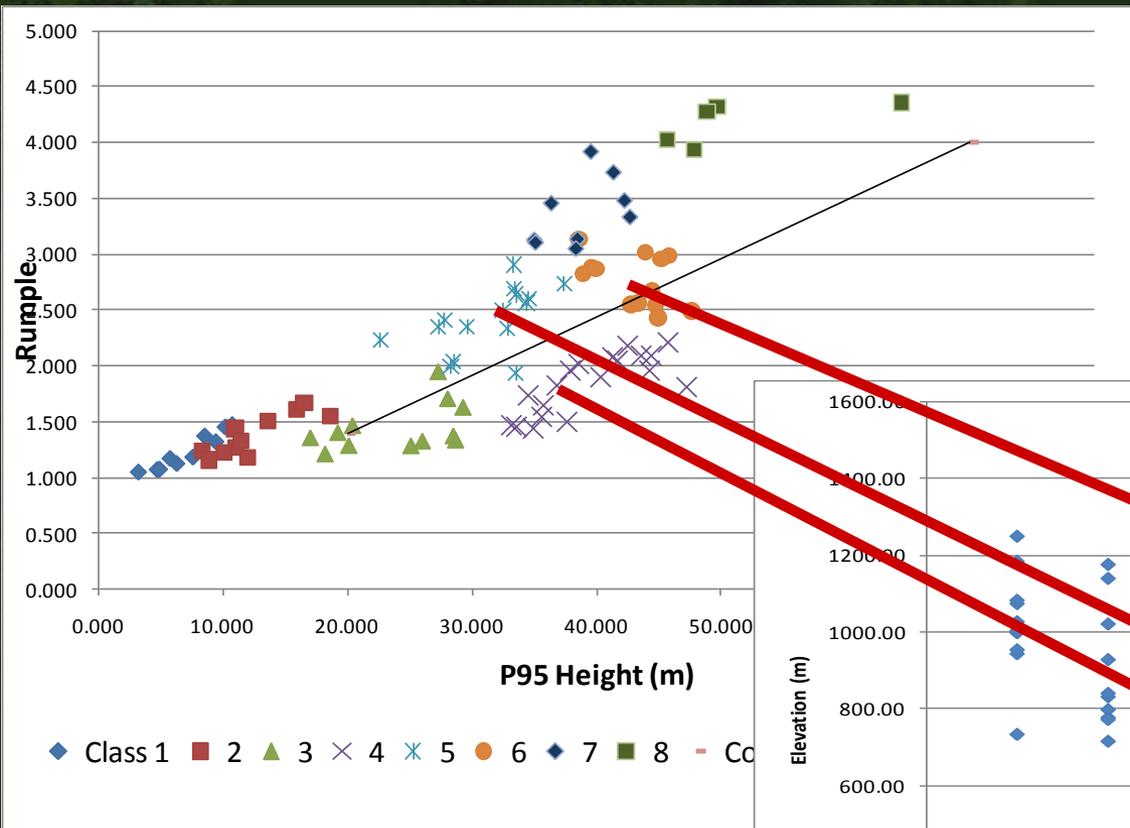
*Solar zenith angles 29-49 degrees

Classifying Structure

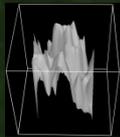


Eight classes identified through hierarchical cluster analysis using p95 height, rumple, canopy density

Relating Structure to Age & Zone

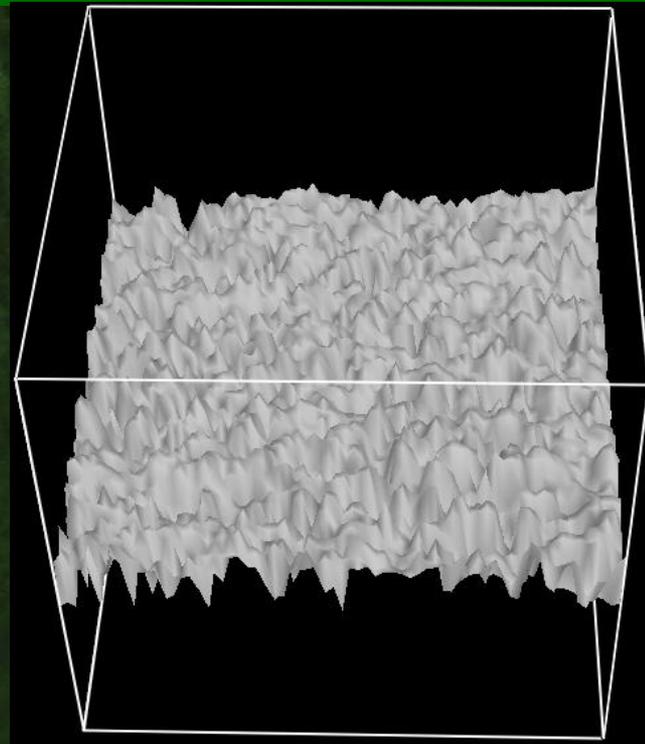


Looking At Larger Scales



94

30 m x 30 m



95

300 m x 300 m

10 x 10 0.09 ha plots/grid cells

Cumulative 8.5 sq km from 36
sq km reserve

**Add variation
to class
definition**

Conclusions and Next Steps

- ◆ *Self-shadowing only moderately correlated with age*
- ◆ *Forest structural complexity only moderately correlated with age*
- ◆ *Including variation likely to help*

Follow on studies

- ◆ *Relate LiDAR structure measurements to Tasseled Cap, SMA*
- ◆ *Utilize ASTER stereo 3N/3B bands*