Seeing the trees in the forest when estimating riparian shade

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Introduction

- Shade requirements for streams are typically included in riparian forest management rules
- Two common shade modeling approaches
  - View to sky: Assumes a solid wall of trees adjacent to a stream
  - Uniform property slabs: Assumes uniform light transmission and other properties for large volumes representing the canopy and understory of forests adjacent to streams
- These two approaches fail to recognize the discrete nature of trees, canopy gaps, opaque boles, tree locations, etc.
- Modern desktop computing power makes it feasible to consider an individual tree shade model

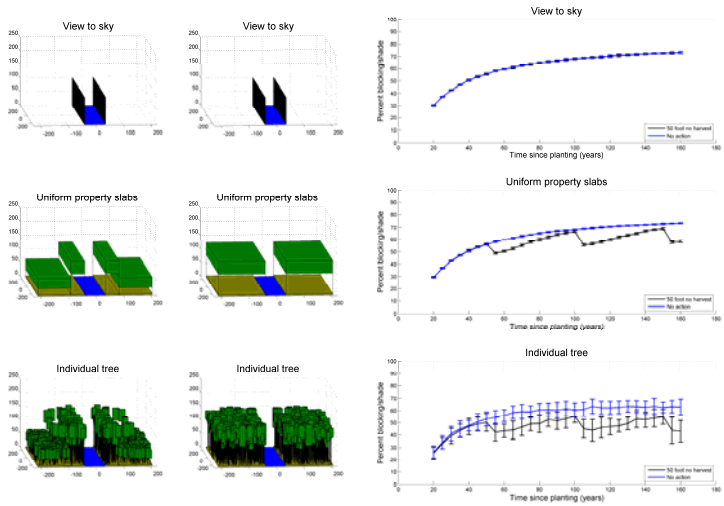
Objectives

- Compare the view to sky shade model, the uniform property slab shade model, and an individual tree shade model
  - Use ray-tracing to model light transmission
  - Use bootstrap simulation to estimate variability
- Identify strengths and weaknesses of the three shade modeling approaches

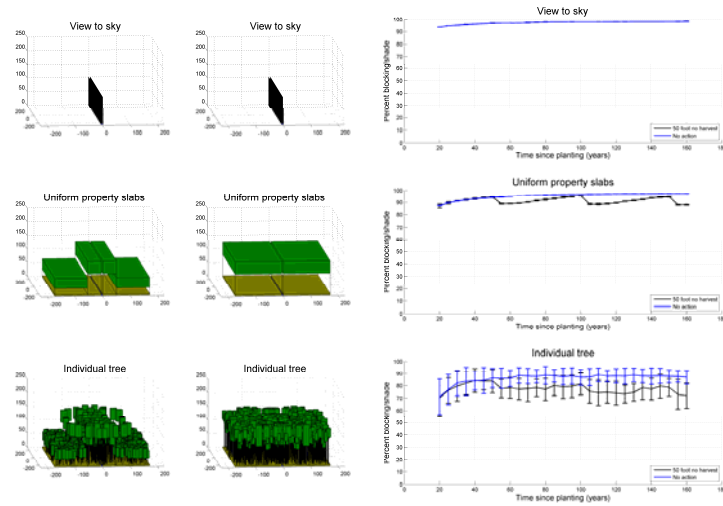
Methods

- Model a 170 foot wide riparian zone (RMZ) on both sides of a stream
  - Four identical one acre forests
  - Two on each side of a stream
  - 512 feet of stream reach
- Consider two management scenarios
  - 50 foot no harvest buffer with a 50 year rotation
  - No action
- Consider two stream sizes
  - Large stream: 75 foot bank full width
  - Small stream: 5 foot bank full width

Large Stream: 75 feet



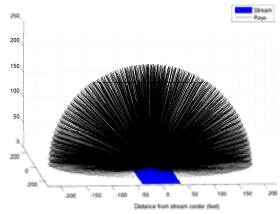
Small Stream: 5 feet



Ray-tracing

- Assume a sinusoidal profile for initial light energy and azimuth values from 0° to 90°
- Generate a set of rays projected from the center of the stream and forested RMZ
- Project the rays through the forest using each shade modeling approach
- Shade/blocking is the ratio of obstructed light transmission to unobstructed light transmission

Rays for shade/blocking



Light attenuation coefficients

Canopy	0.95 per foot
Under canopy	0.99 per foot
Tree crown	0.95 per foot
Tree bole	0.00 per foot
Shrub Layer	0.84 per foot

Conclusions

- The view to sky approach is not useful for making relative comparisons among management scenarios
- The uniform property slabs approach allows relative comparisons among management scenarios but underestimates variability
- View to sky and uniform property slab approaches both overestimate blocking/shade relative to the individual tree approach used here
- The individual tree approach clearly shows the influence of the discrete nature of trees through the increased variability