Landscape-Level Forest Biomass and Residue Estimation

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COLLEGE OF FORESTRY AND CONSERVATION

Where Ideas Take Flight

Forest Biomass

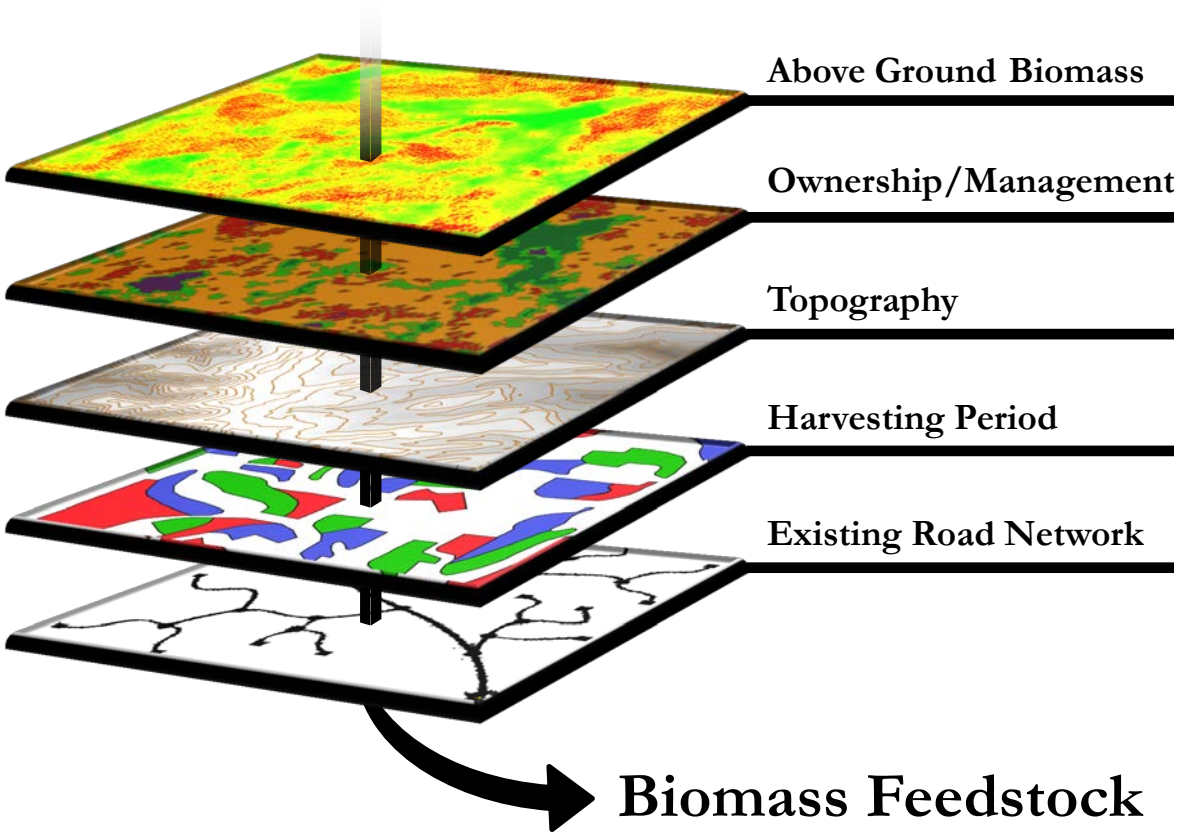
Forest Biomass

OR

Forest Biomass

- Ecologically Available Biomass
- Technically Available Biomass
- Economically Available Biomass
- Biomass Stocks

Forest Biomass



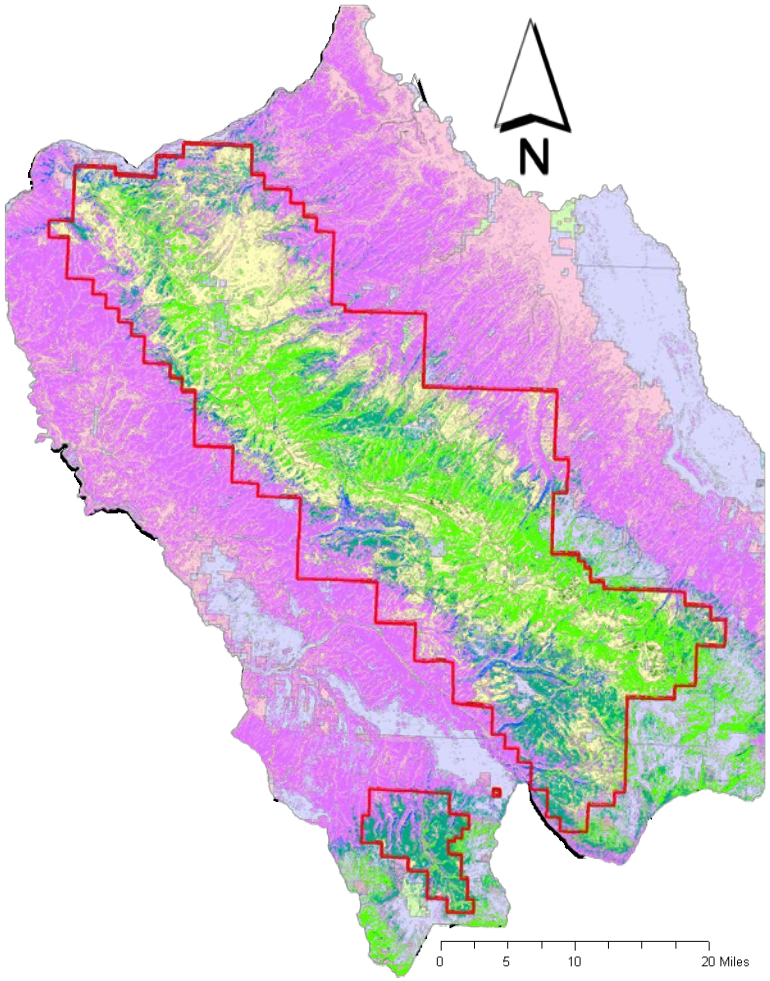
Forest Biomass

- Estimate Above Ground Biomass
- Estimate merchantable stock
- For large landscape with stand-level detail

Estimating AGB

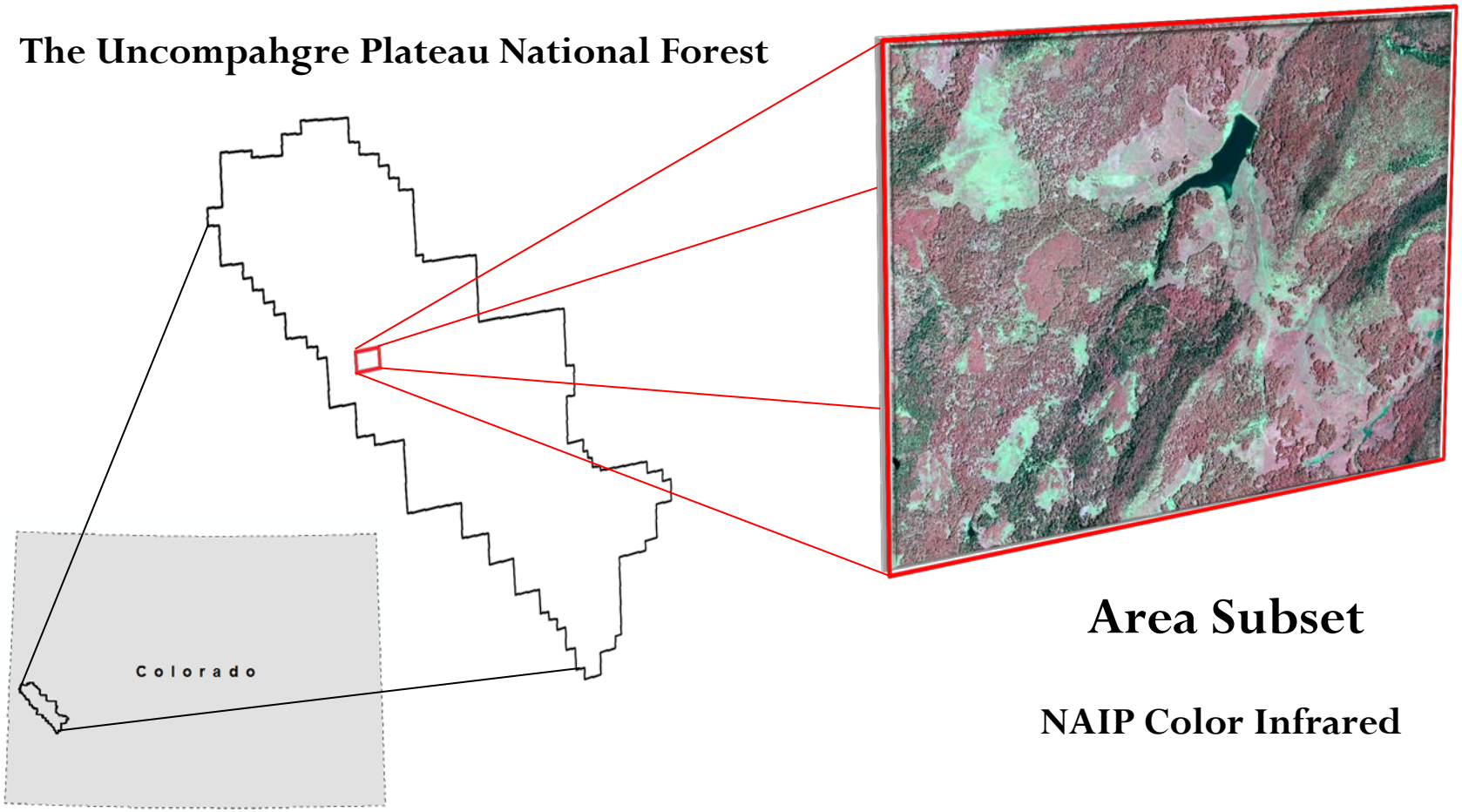
- Classical methods are expensive
- Remote sensing as an alternative
  - Use high resolution imagery for stand level detail to address management related questions
  - Link with field data to estimate forest characteristics based on imagery attributes

The Uncompahgre



The Uncompahgre

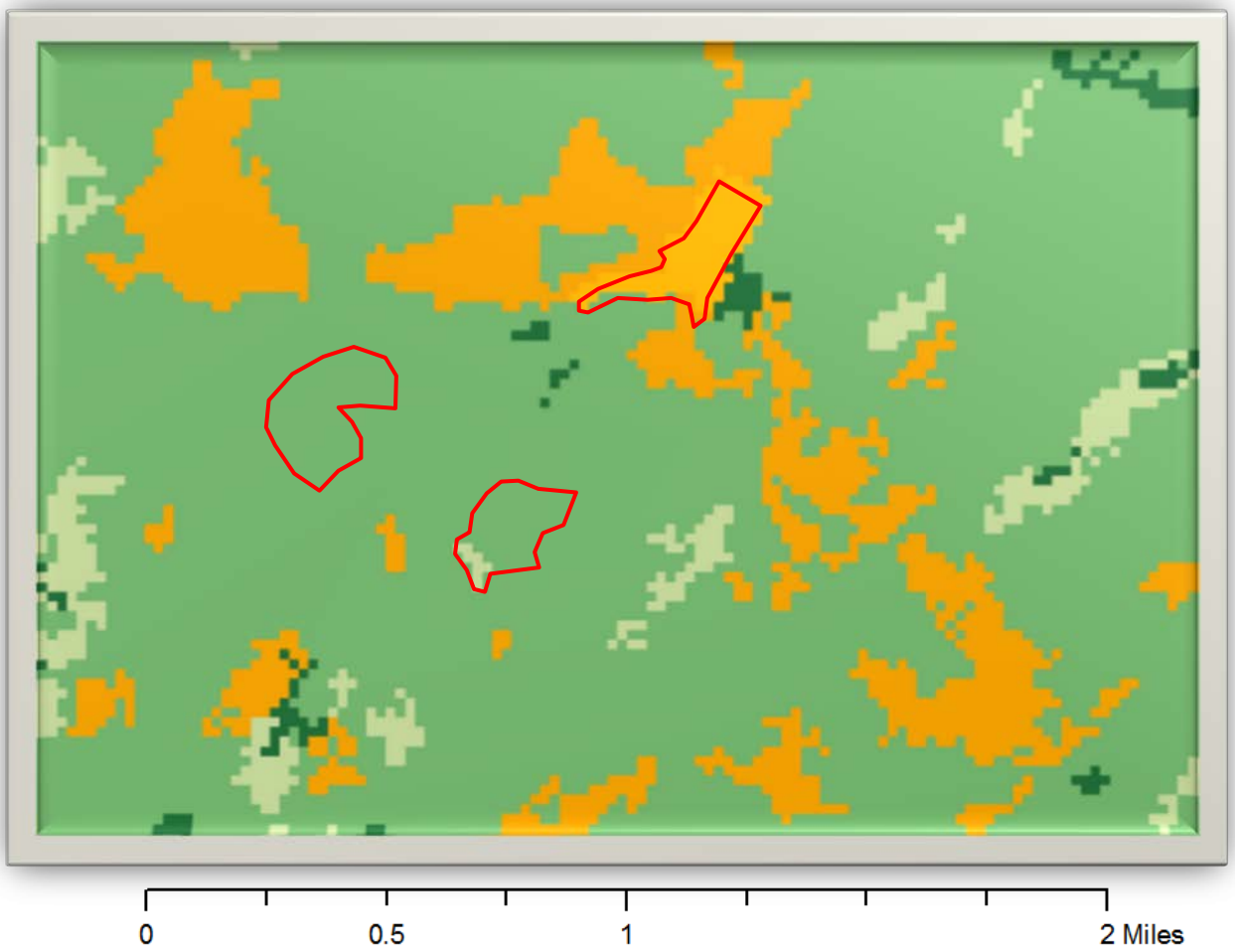
The Uncompahgre Plateau National Forest



Area Subset

NAIP Color Infrared

Modeling AGB



Modeling AGB

Probabilistic Classification Model

- Polytomous Logistic Regression

Forest Characteristics Model

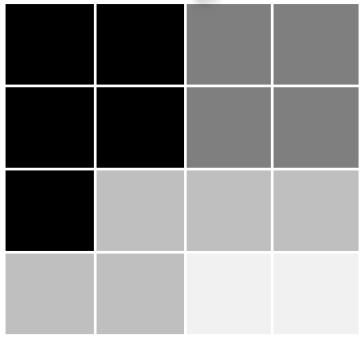
- Use existing field data
- Find a relationship between field data, texture, and probabilistic outputs

Modeling AGB

Texture

- Gray Level Co-Occurrence Matrix (GLCM)

Image



Values

0→	0→	1→	1
0→	0→	1→	1
0→	2→	2→	2
2→	2→	3→	3

Framework (East)

	0	1	2	3
0	2	2	1	0
1	0	2	0	0
2	0	0	3	1
3	0	0	0	1

Modeling AGB

Texture

- Gray Level Co-Occurrence Matrix (GLCM)

East Matrix				+	Transpose West				=	Symmetrical (Horizontal)			
2	2	1	0		2	0	0	0		4	2	1	0
0	2	0	0		2	2	0	0		2	4	0	0
0	0	3	1		1	0	3	0		1	0	6	1
0	0	0	1		0	0	1	1		0	0	1	2

Modeling AGB

Texture

- Gray Level Co-Occurrence Matrix (GLCM)

Symmetrical (Horizontal)

4	2	1	0
2	4	0	0
1	0	6	1
0	0	1	2

Normalization

$$P_{i,j} = \frac{V_{i,j}}{\sum_{i,j=0}^{N-1} V_{i,j}}$$

Normalized

0.2	0.1	0.05	0
0.1	0.2	0	0
0.05	0	0.3	0.05
0	0	0.05	0.2

Modeling AGB

Stage 1 Modeling

- **Response:**

  Species Group

- **Independent variables:**

  Training data

  PCA 1-3

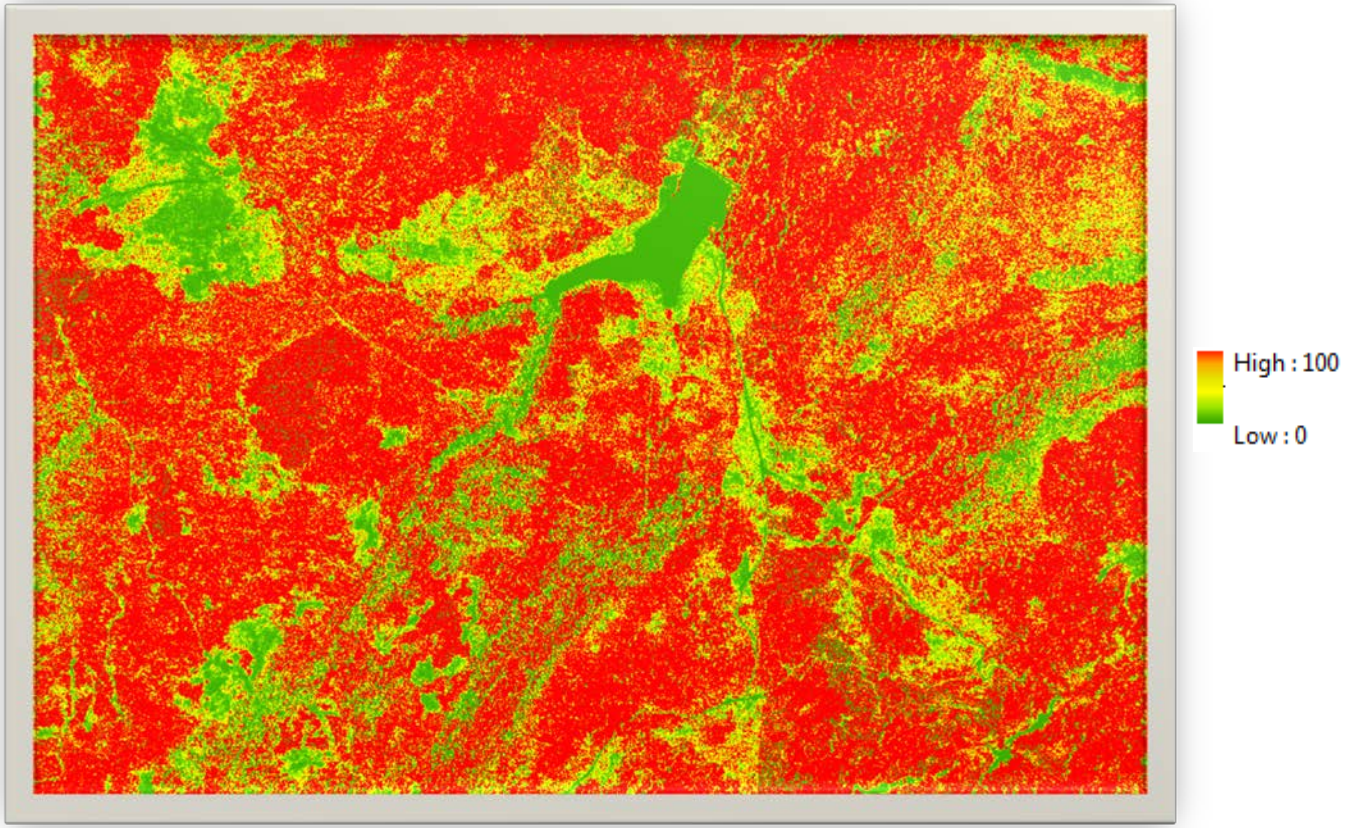
  Principle Component Analysis

  Horizontal Homogeneity

  GLCMs

  Vertical and Horizontal Correlation

Modeling AGB



Modeling AGB

Stage 2 – Forest Characteristics

- **Response:**

  Summarized Field Data for AGB, BAA and TPA

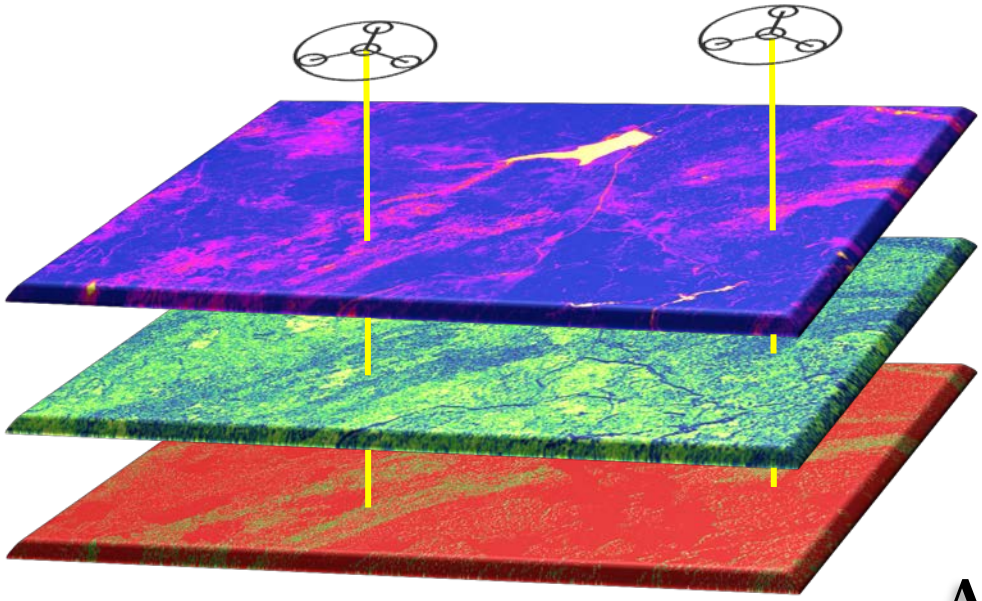
- **Independent variables:**

  Principle Component Analysis

  GLCMs

Modeling AGB

Aspen



PCA Band 3

Horizontal Correlation

Shadow Probability

Aspen AGB, BAA & TPA

$R^2 = 0.69 - 0.78$

Modeling AGB

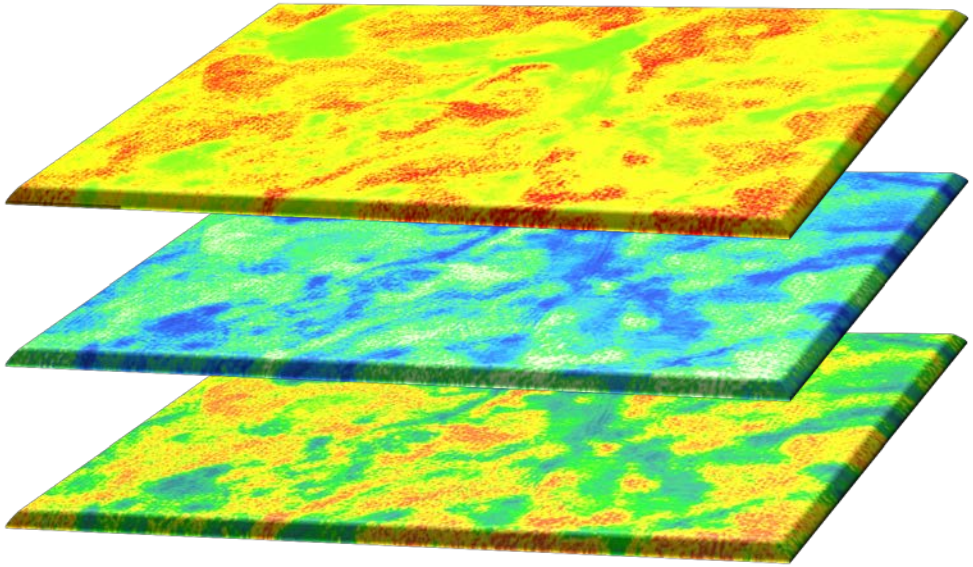
Combine Stage 1 & 2

Probabilistic Outputs **X**

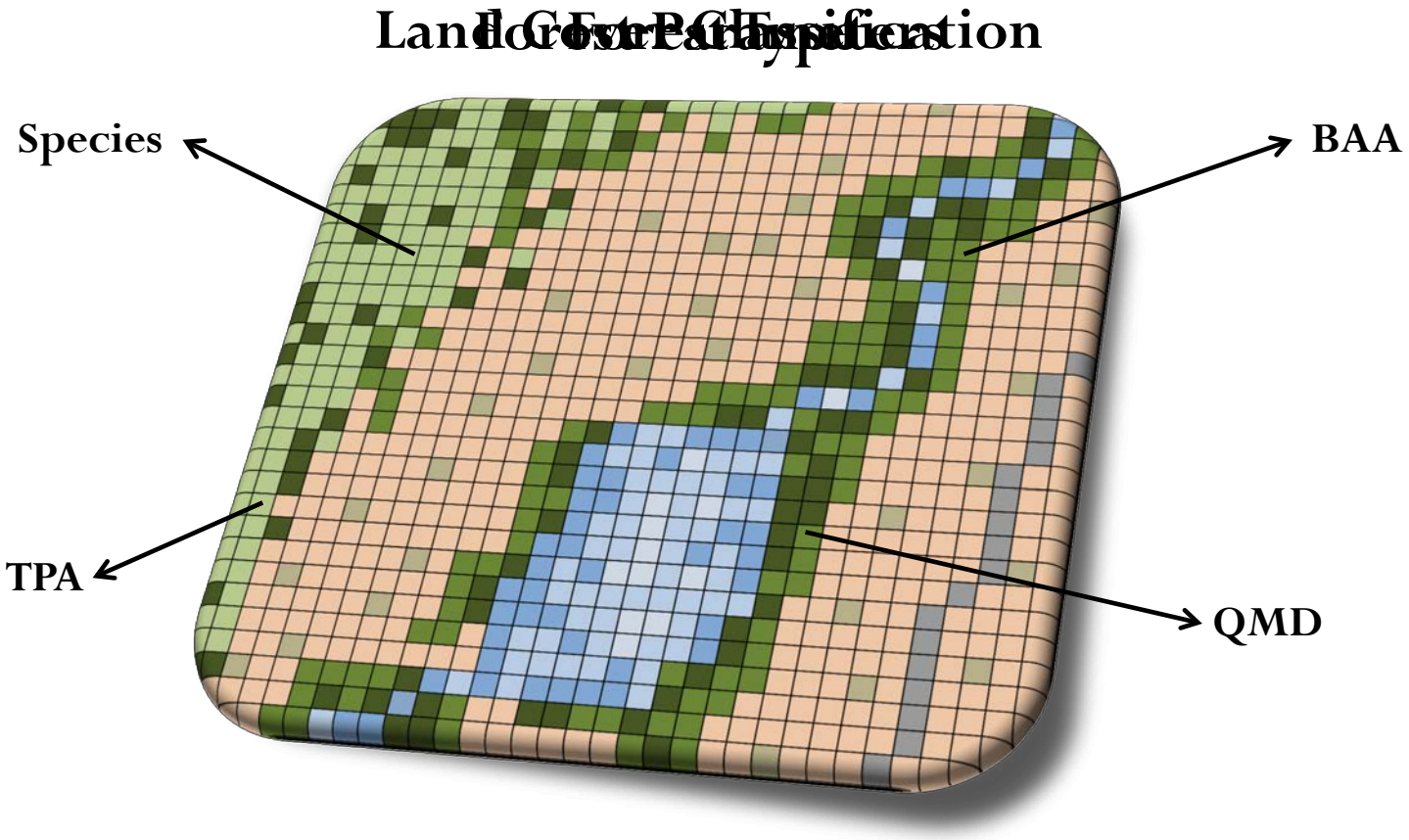
$$AGB_i = \alpha + \beta_{ij} X_j$$

$$BAA_i = \alpha + \beta_{ij} X_j$$

$$TPA = \alpha + \beta_{ij} X_j$$



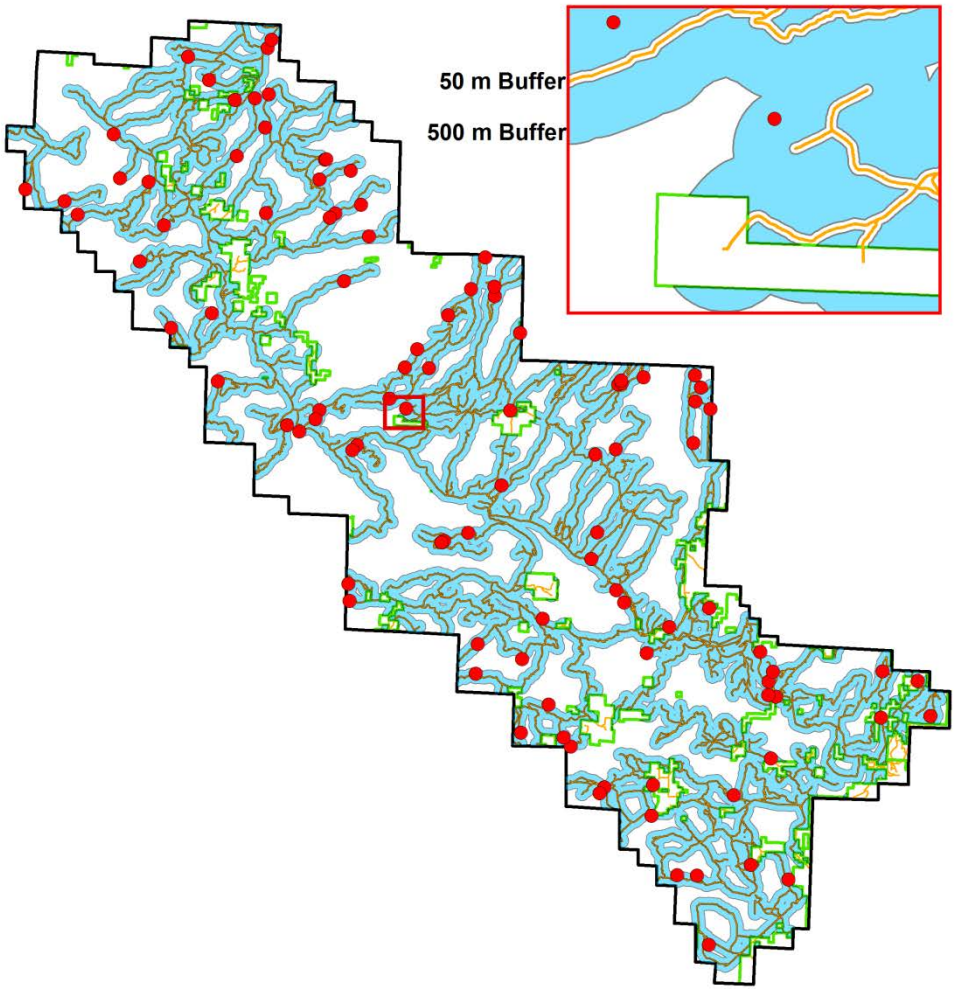
Validation



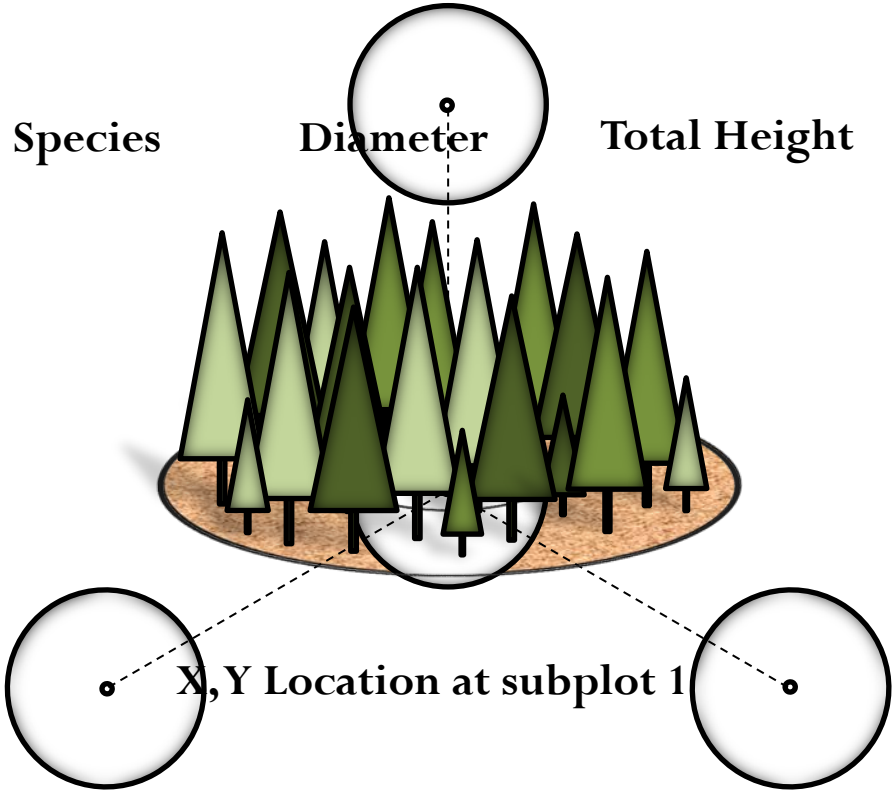
Validation

- Spatially Distributed Sample
- Optimal Sample Intensity
- Consistency

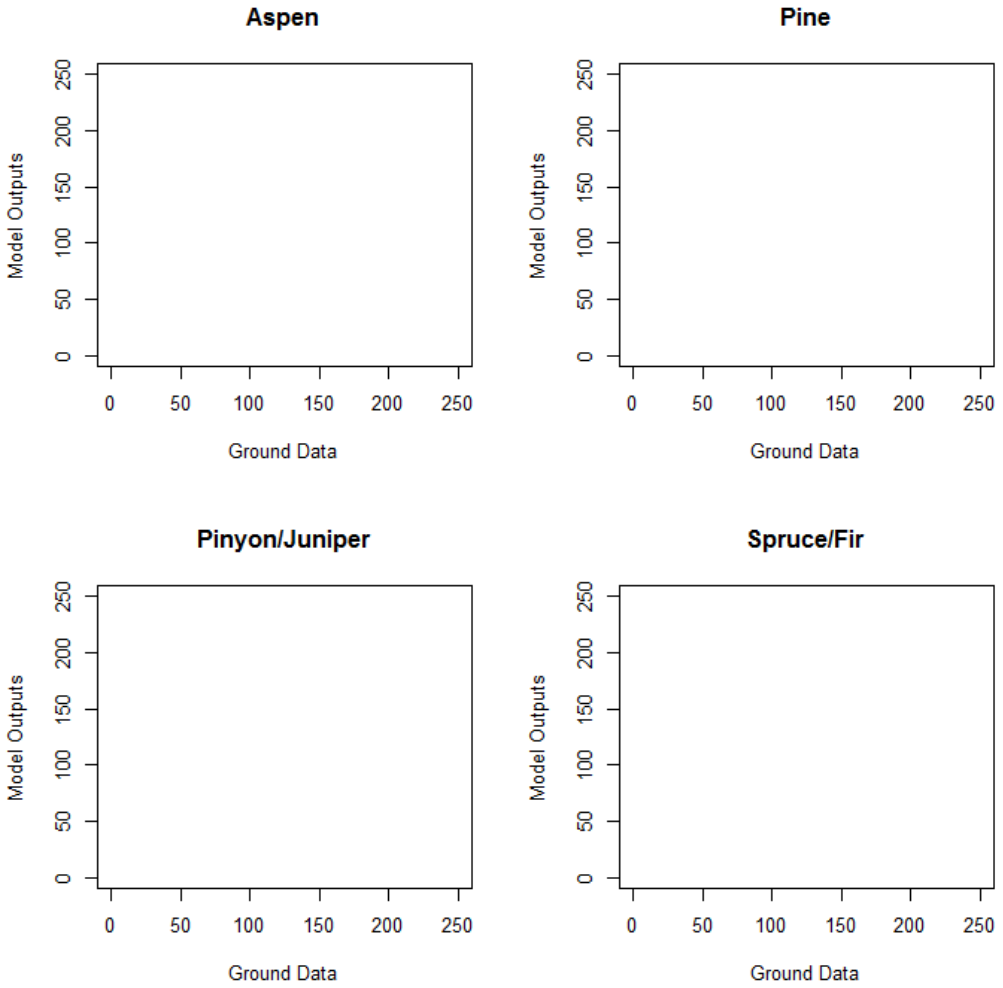
Validation



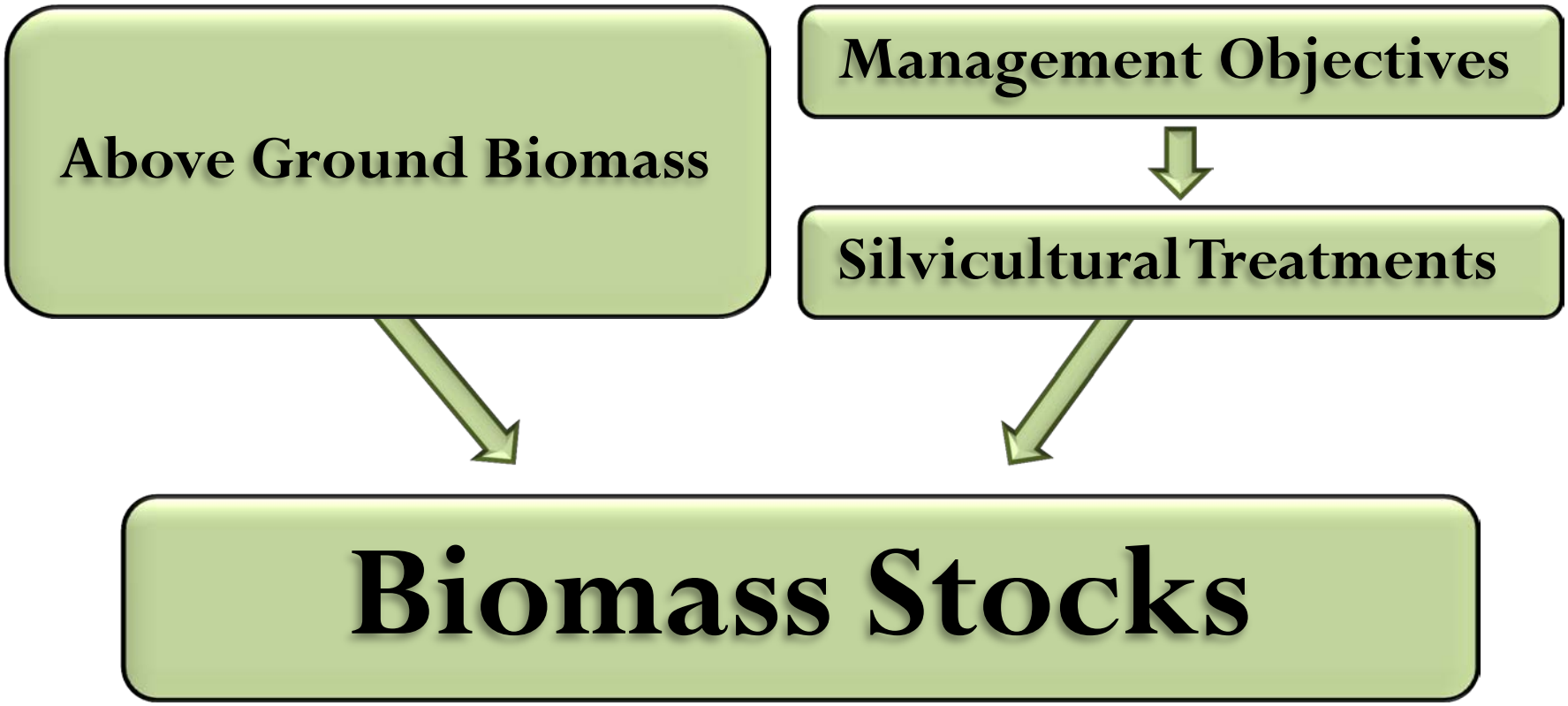
Validation



Validation

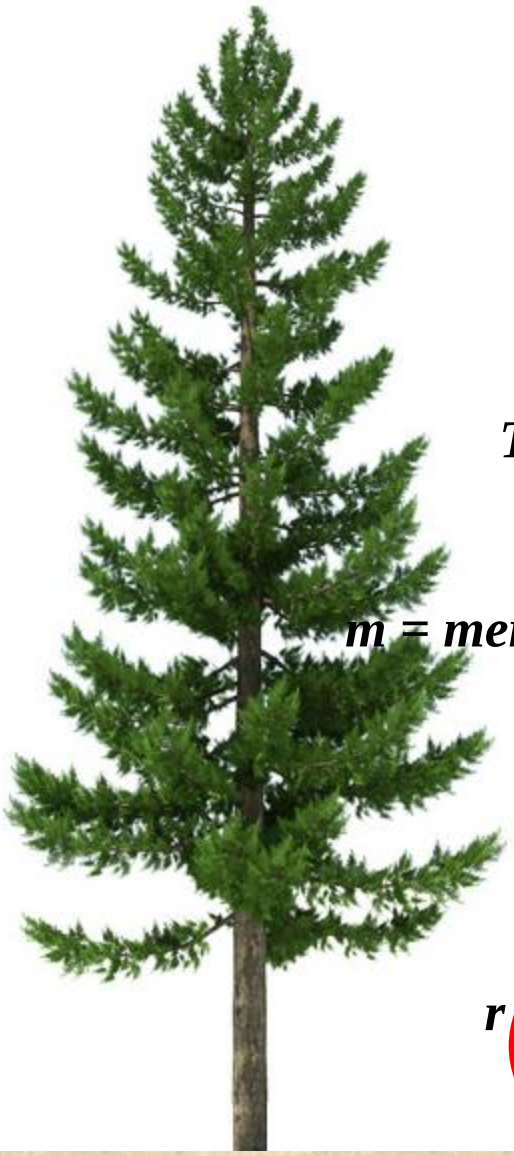

Aspen
Model Outputs
Ground Data
0
50
100
150
200
250
Pine
Model Outputs
Ground Data
Pinyon/Juniper
Model Outputs
Ground Data
Spruce/Fir
Model Outputs
Ground Data

Treatment Residues



$$A_{bio} = (T - m)$$

$$R_{bio} = r(T - m)$$



T = total biomass

m = merchantable stock

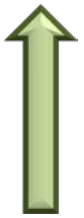
Recoverable Residues

r = % recoverable of available

Available Residues

Treatment Residues

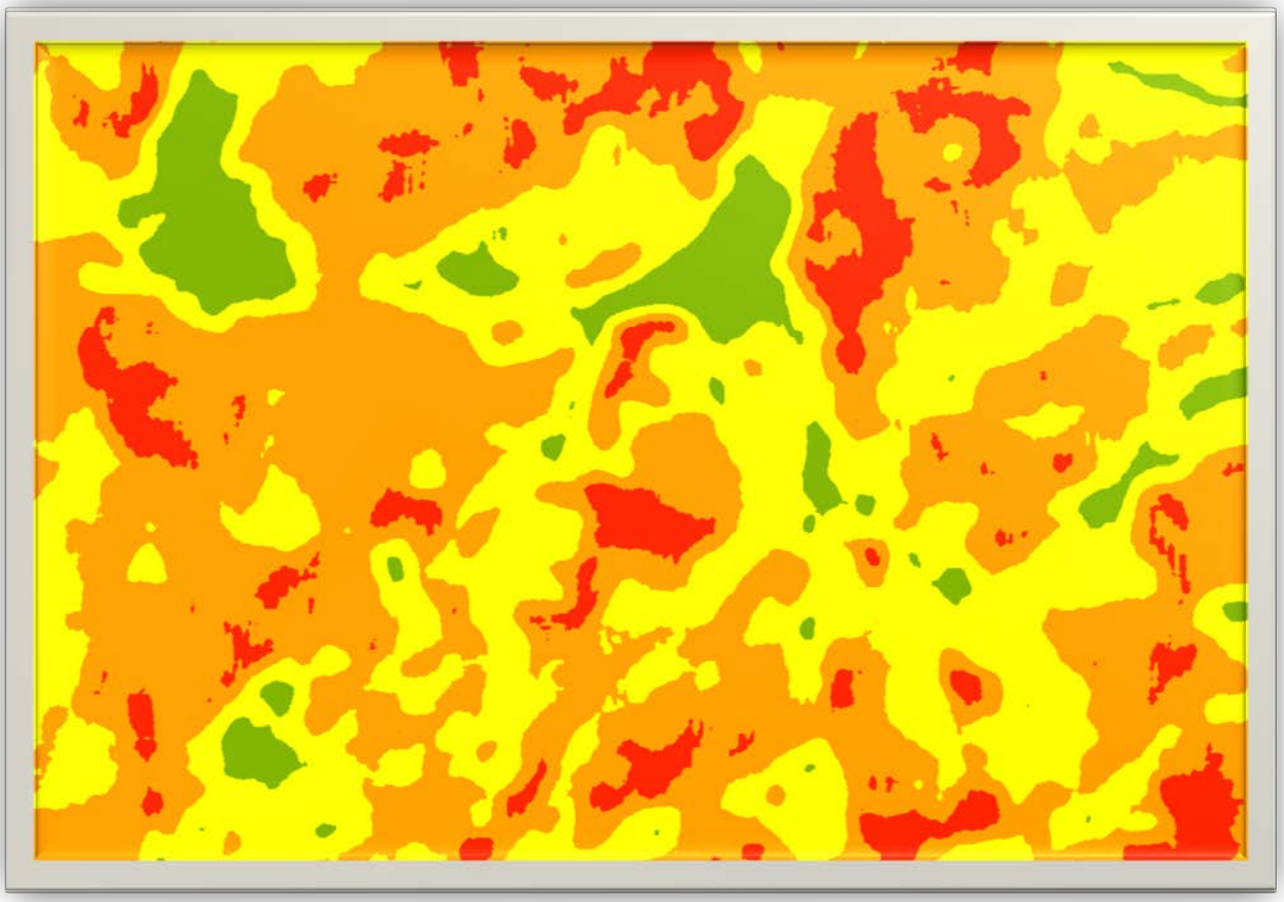
Biomass Stocks = Total AGB – Merchantable Stock – Retention

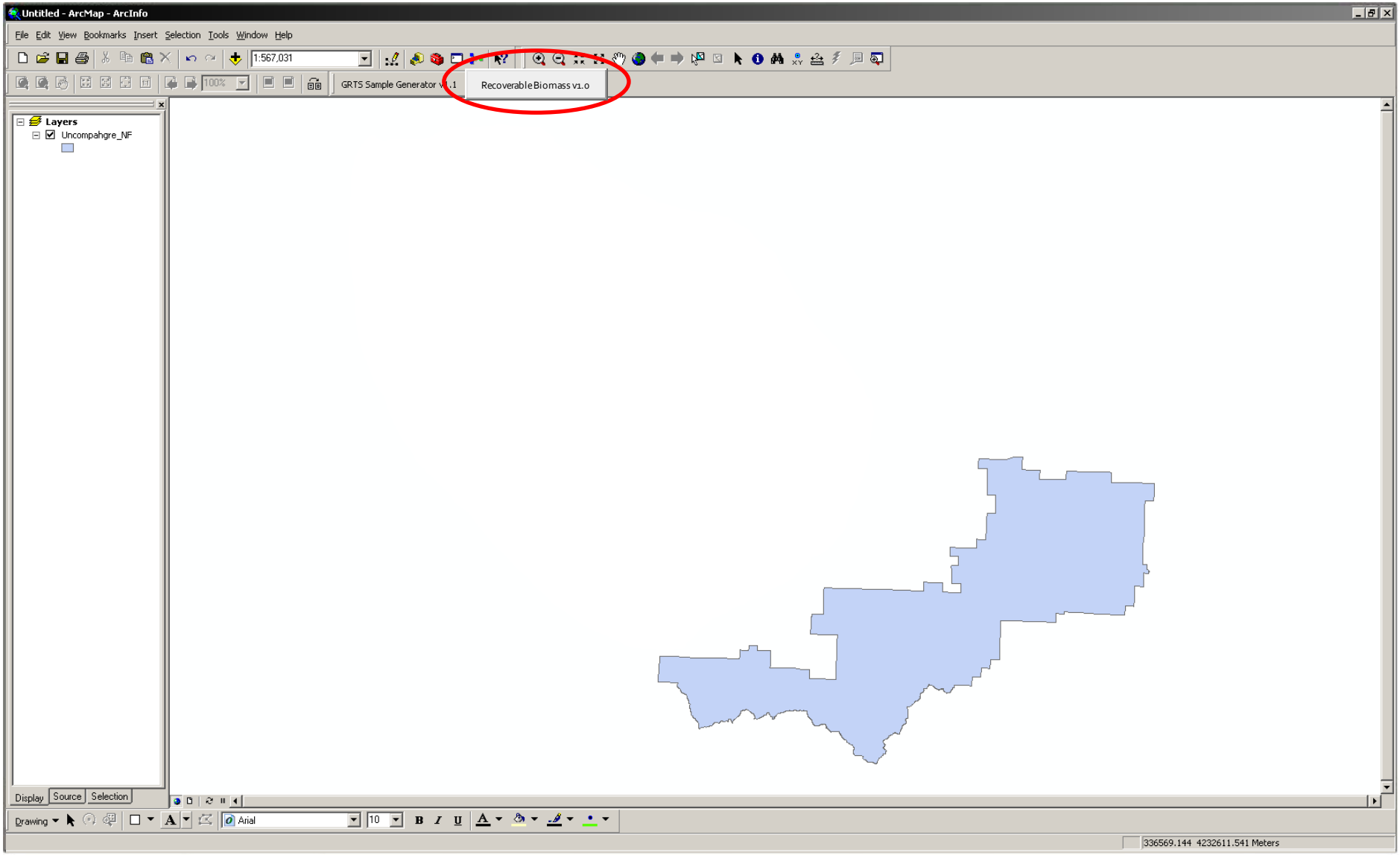


Treatment Residues

- Regional Sense of Merch
- Estimate Merch for Field Data
- Categorize by Characteristics

Treatment Residues

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GRTS Sample Generator v1.1
Recoverable Biomass v1.0
Layers
Uncompahgre_NF
Display Source Selection
Drawing
Arial
10
336569.144 4232611.541 Meters

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