High Resolution Ecosystem Modeling as Part of a Robust Carbon Monitoring System

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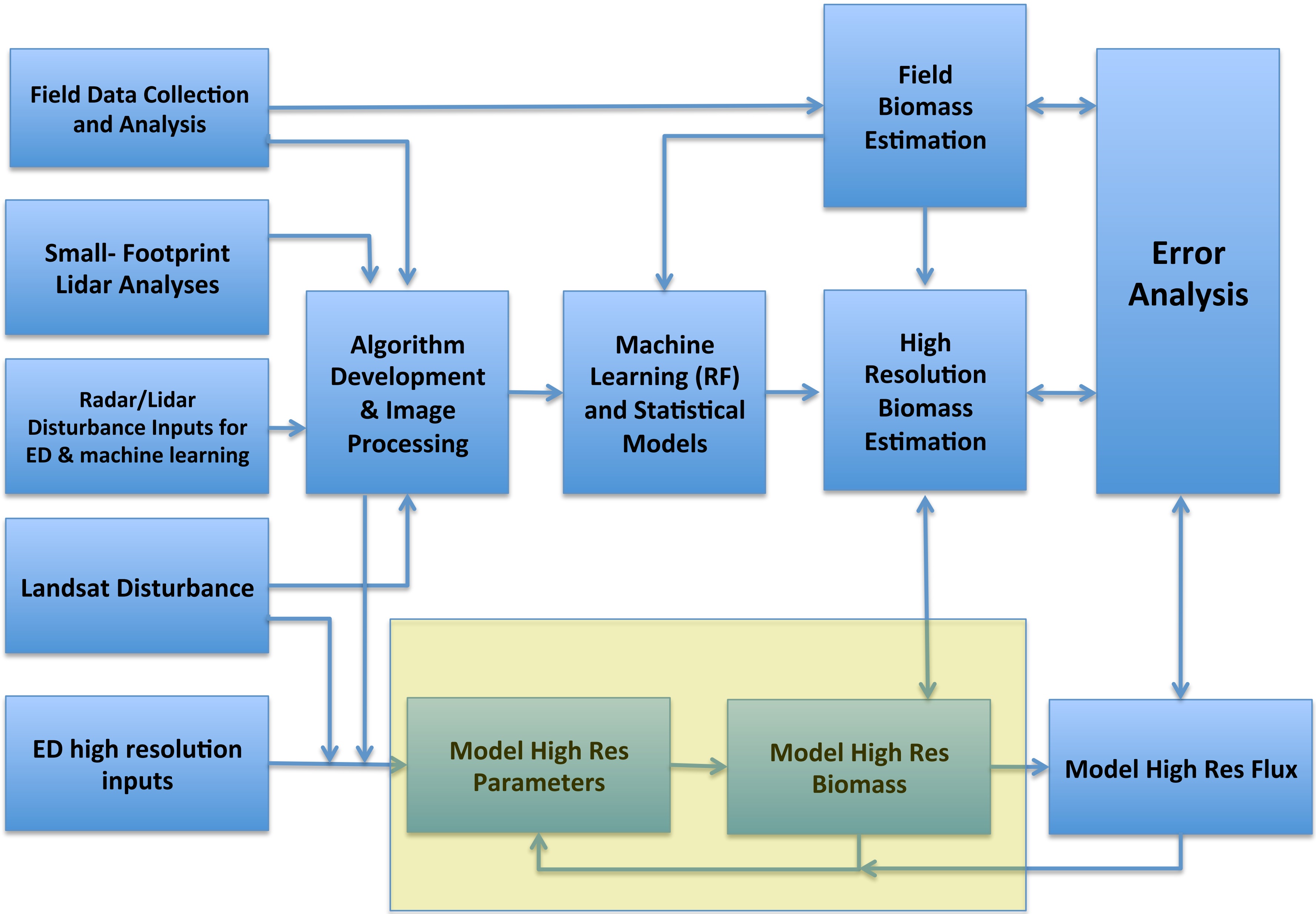
UMD CMS Contributions



AGU, December 2011

Study Objectives

The Ecosystem Demography (ED) Model: Incorporates fine-scale processes into a global ecosystem model.

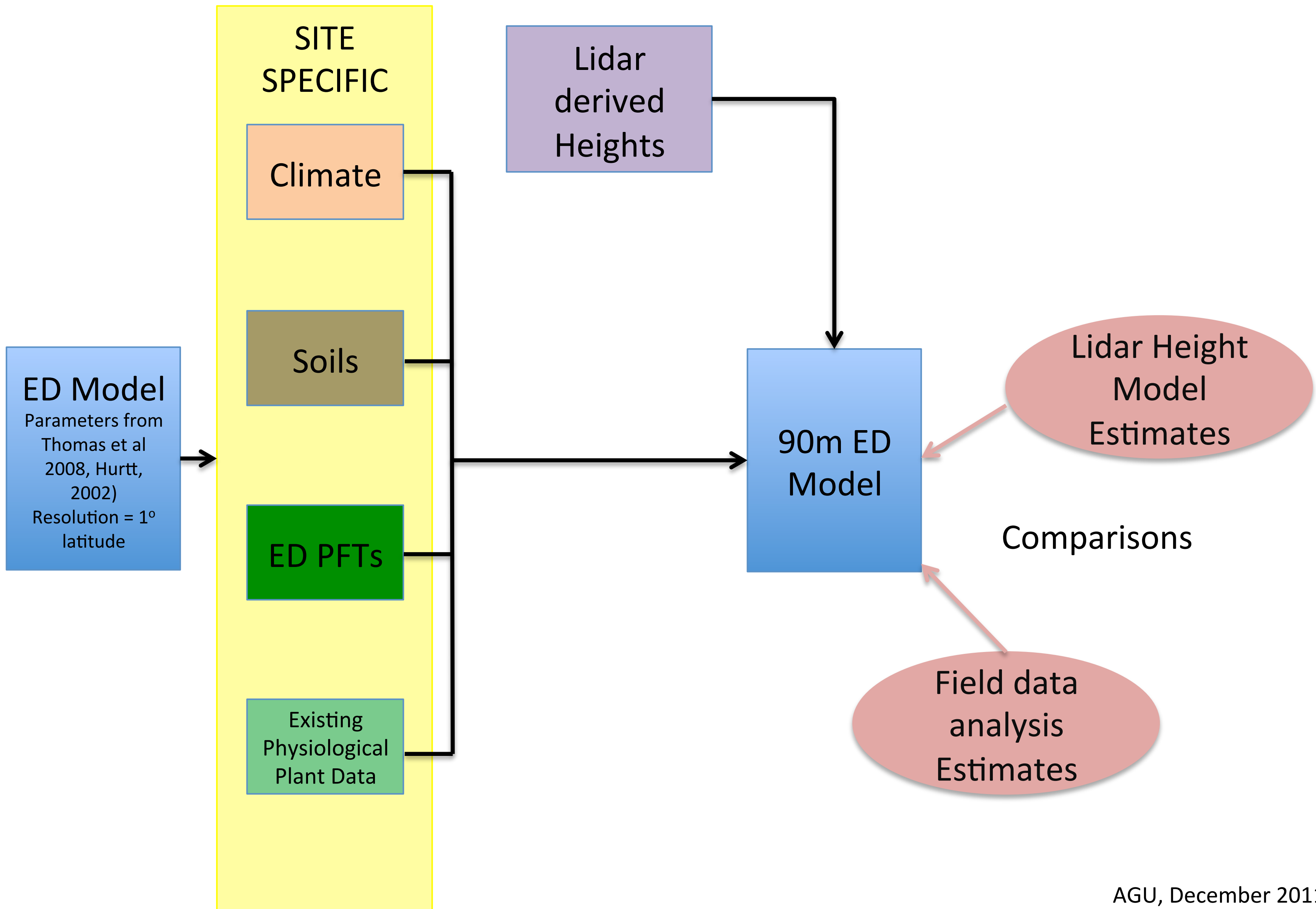
Our Objective: Develop a framework to model vegetation dynamics at 90m resolution over large geographic areas

2 Key Study Questions:

1) What are the high resolution carbon stocks and fluxes (past, present, future) over the study domain?

2) How do different input datasets improve and/or constrain model estimates?

Methodology



ED Existing PFT Verification

$$IVI_i = (A_i \times 100) + (F_i \times 100) + (D_i \times 100)$$

where:

$$A_i = \text{Abundance}_i = \frac{\text{stem count of species i}}{\text{stem count of all species}}$$

$$F_i = \text{Frequency}_i = \frac{\text{occurrence of species i}}{\text{occurrence of all species}}$$

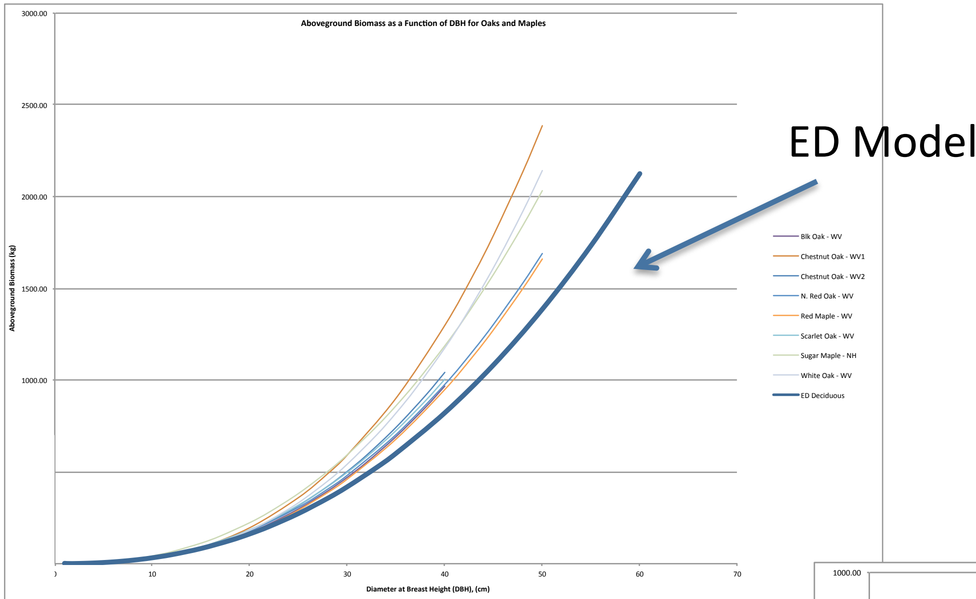
$$D_i = \text{Dominance}_i = \frac{\text{basal area of species i } [m^2/ha]}{\text{total basal area } [m^2/ha]}$$

(Curtis and McIntosh 1951; Kent and Coker 1994)

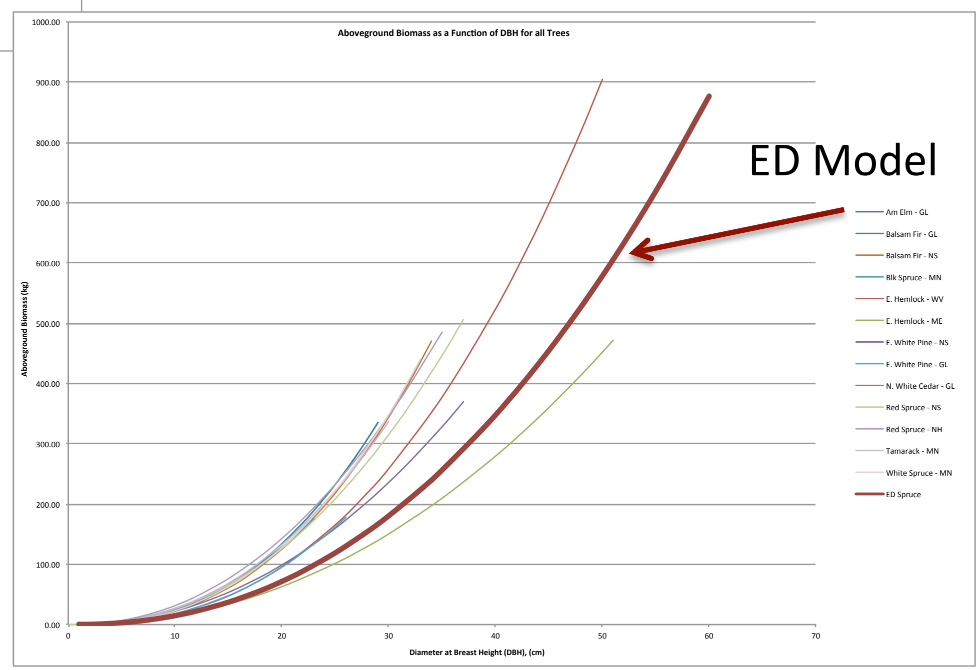
ED Species Verification

✔

Oak and Maple Aboveground Biomass as a Function of DBH

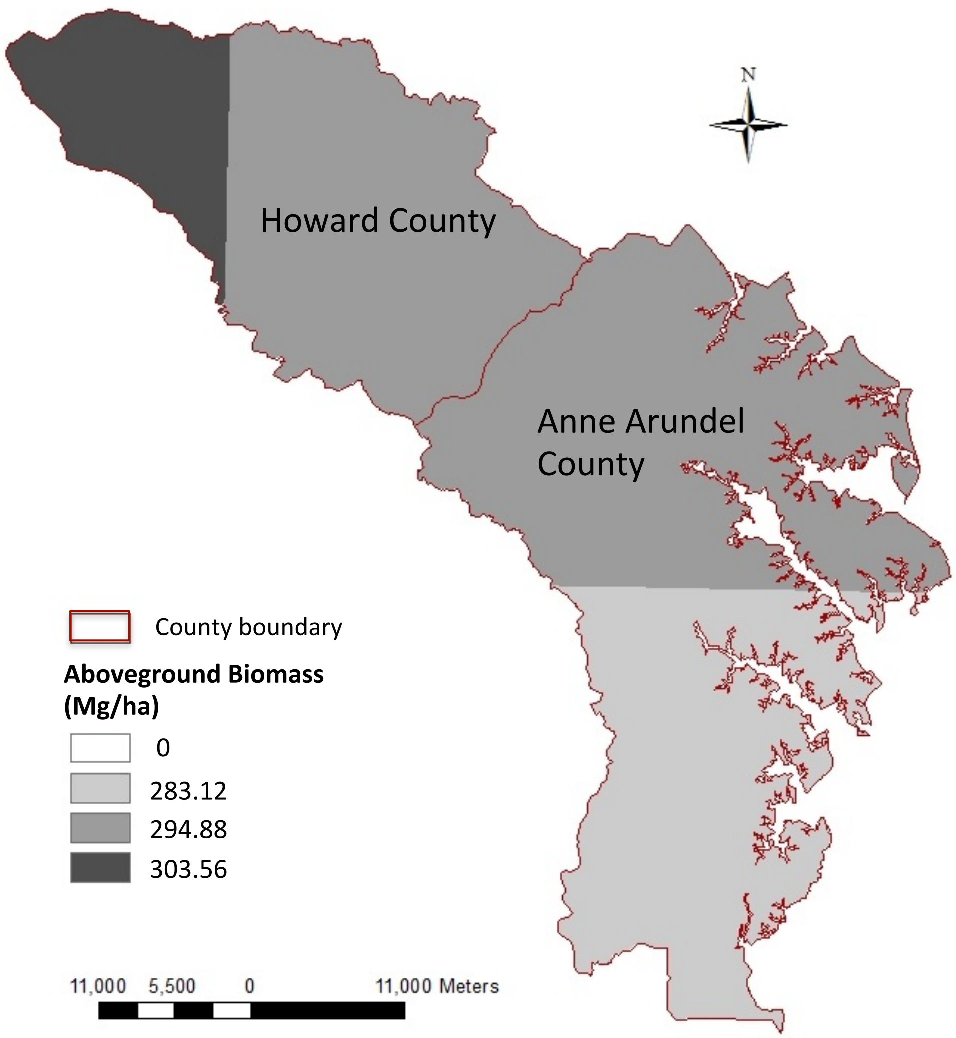


Evergreen Aboveground Biomass as a Function of DBH



High Resolution ED Model Experimental Approach

ED Version	1° Climate	0.25° Climate	1° Soil	1ha Soil	Lidar	LandSat Forest/ Non Forest Mask
Version 1.x, Abiotic/Technologial Focus: Designing repeatable, robust process for running ED at high resolution						
1.0	x		x			
1.1	x			x		
1.2		x	x			
1.3		x		x		
1.4	x			x		x
1.5	x			x	x	x
1.6		x		x	x	x



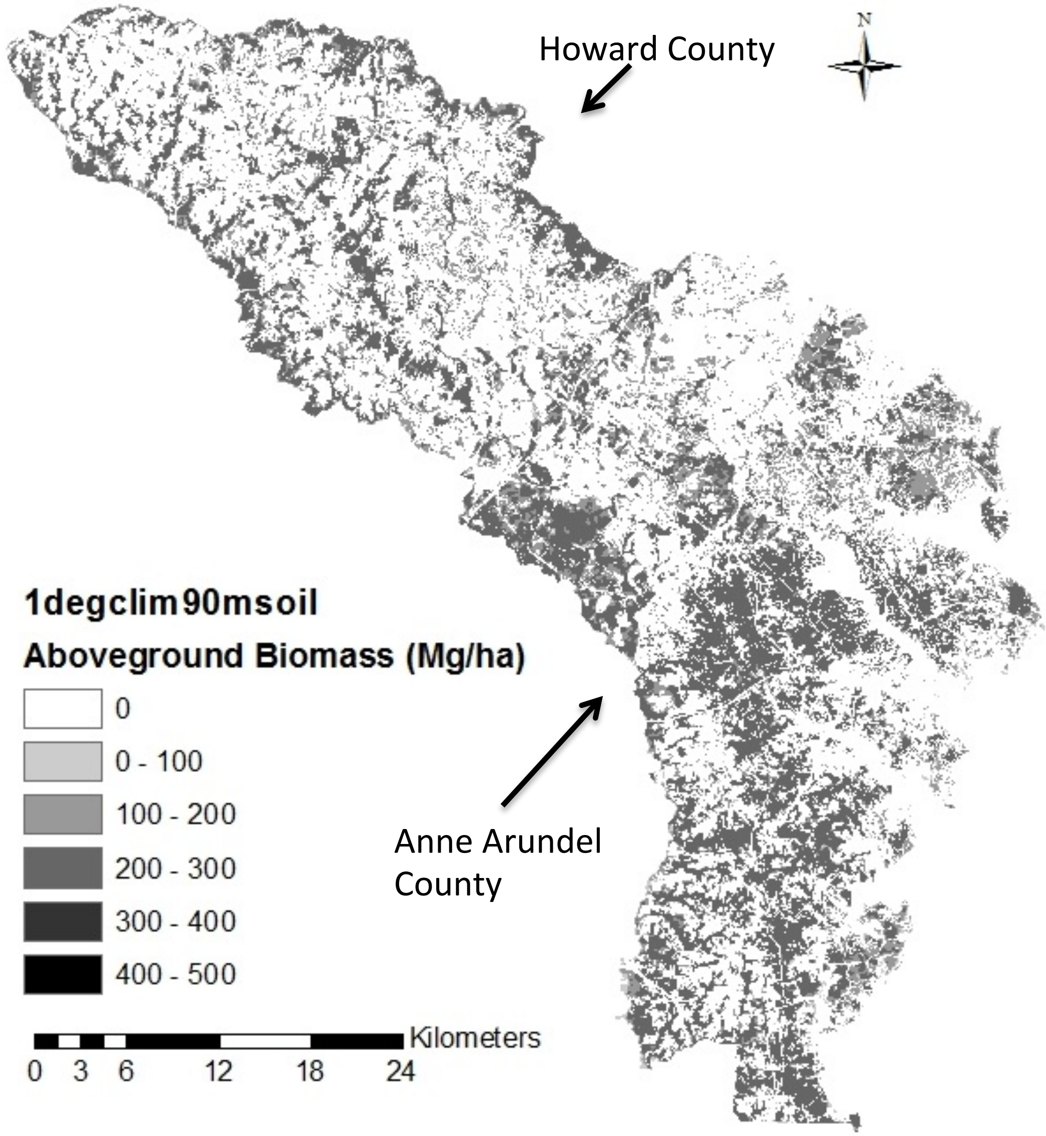
Results

ED Version 1.0

ED Potential Aboveground Biomass (AGB) for Maryland Counties with 1 degree climate and soil initializations

Mean = 293.48 Mg/ha

Results

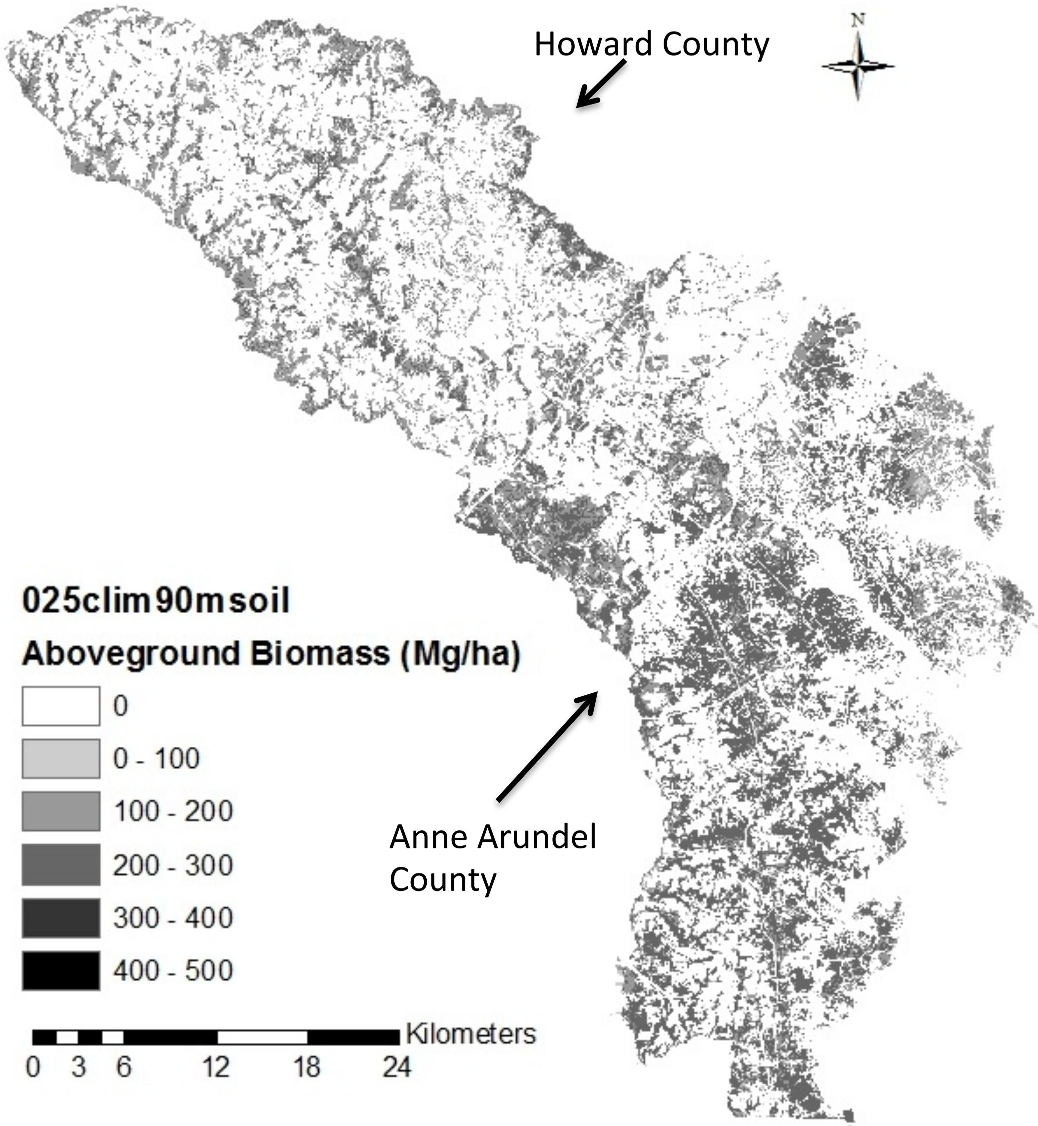


ED Version 1.5

Lidar initialized ED AGB for MD Counties with 1 degree climate and 90m soil inputs, with nlcd 2006 Forest/Non-Forest Mask

Mean = 271.86 Mg/ha

Results



ED Version 1.6

Lidar initialized ED AGB for MD Counties with 0.25-degree climate, 90m soil, with NLCD 2006 Forest/ Non-Forest Mask

Mean = 197.17 Mg/ha

Results

ED Version	Input Description	Total AGB (dry wt kg)	Total C (Tg C)	Avg AGB (kg C/m2)	Avg AGB (Mg/ha)
1.0	1degclim1degsoil	4.90E+10	24.51	14.67	293.48
1.1	1deglim90msoil	5.53E+10	27.66	16.56	331.31
1.3	0.25clim90msoil	6.87E+10	34.35	20.57	411.30
1.4	1degclim90msoil(mask only)	3.87E+10	19.40	11.61	232.34
1.5	1degclim90msoil (mask+lidar)	4.54E+10	22.70	13.59	271.87
1.6	0.25clim90msoil (mask+lidar)	3.29E+10	16.46	9.86	197.17

Lidar Height Metrics (Dubuyah et al) = 220.20

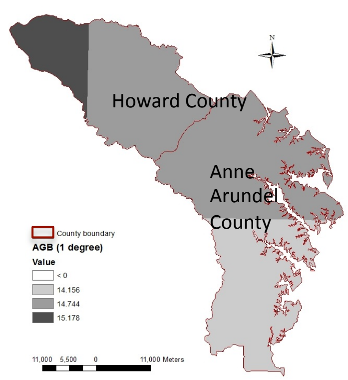
45 Forest - FIA and FIA-like plots (Johnson) = 180.7

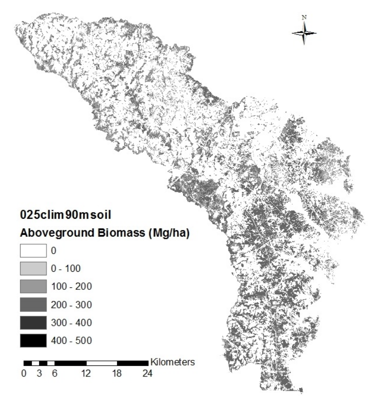
Summary

1) Development of technological capacity – unprecedented resolution
2) High Resolution inputs produced more meaningful biomass values
3) Our results highlight the importance of the high resolution product as well as the interactive effects of soils, lidar and forest masking

Future Directions:

1. Work in progress – further development of enhanced scaling algorithms for increased run efficiency
2. Ecological refinement to match high resolution abiotic inputs





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