

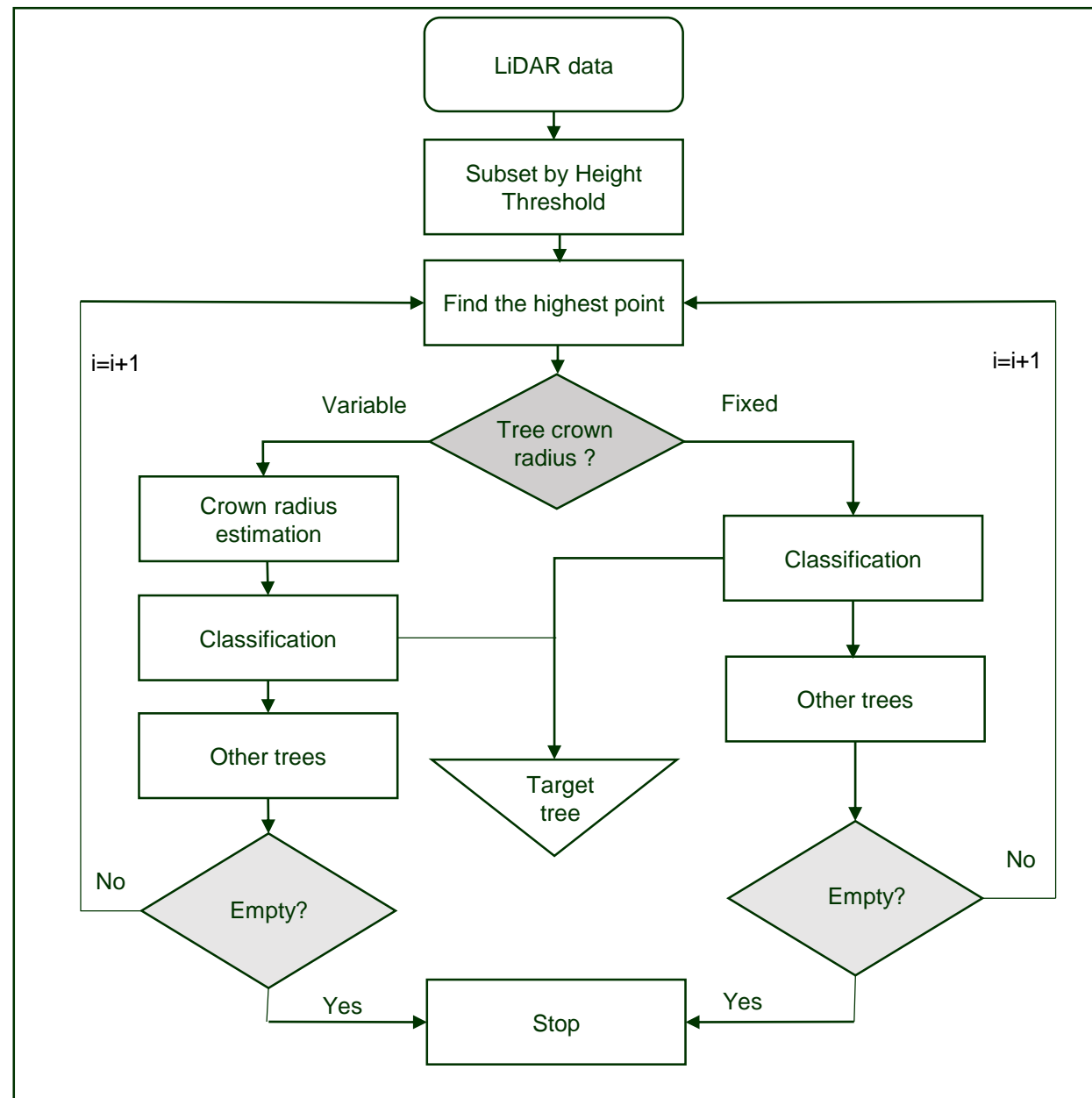
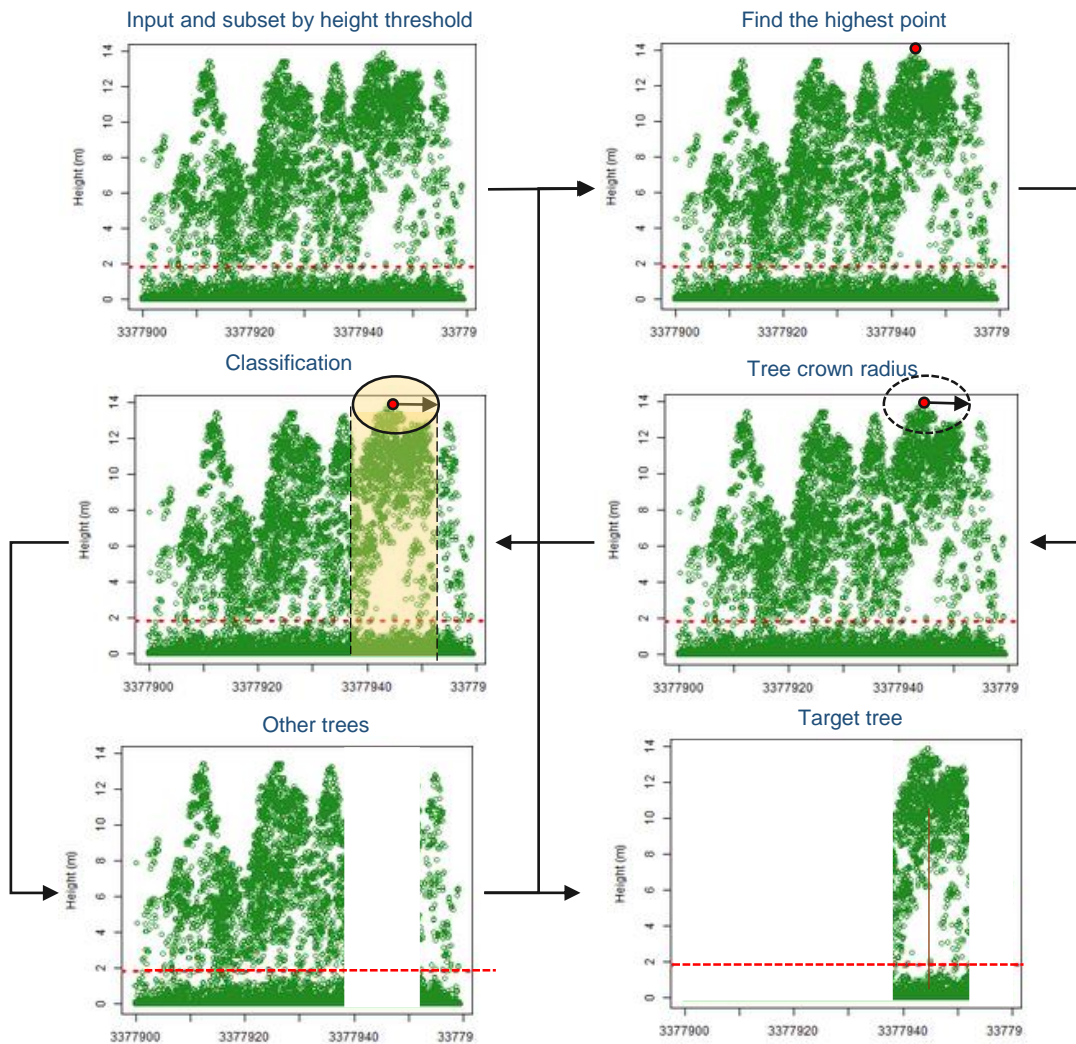


# Tutorial “ Web-LiDAR forest inventory application”



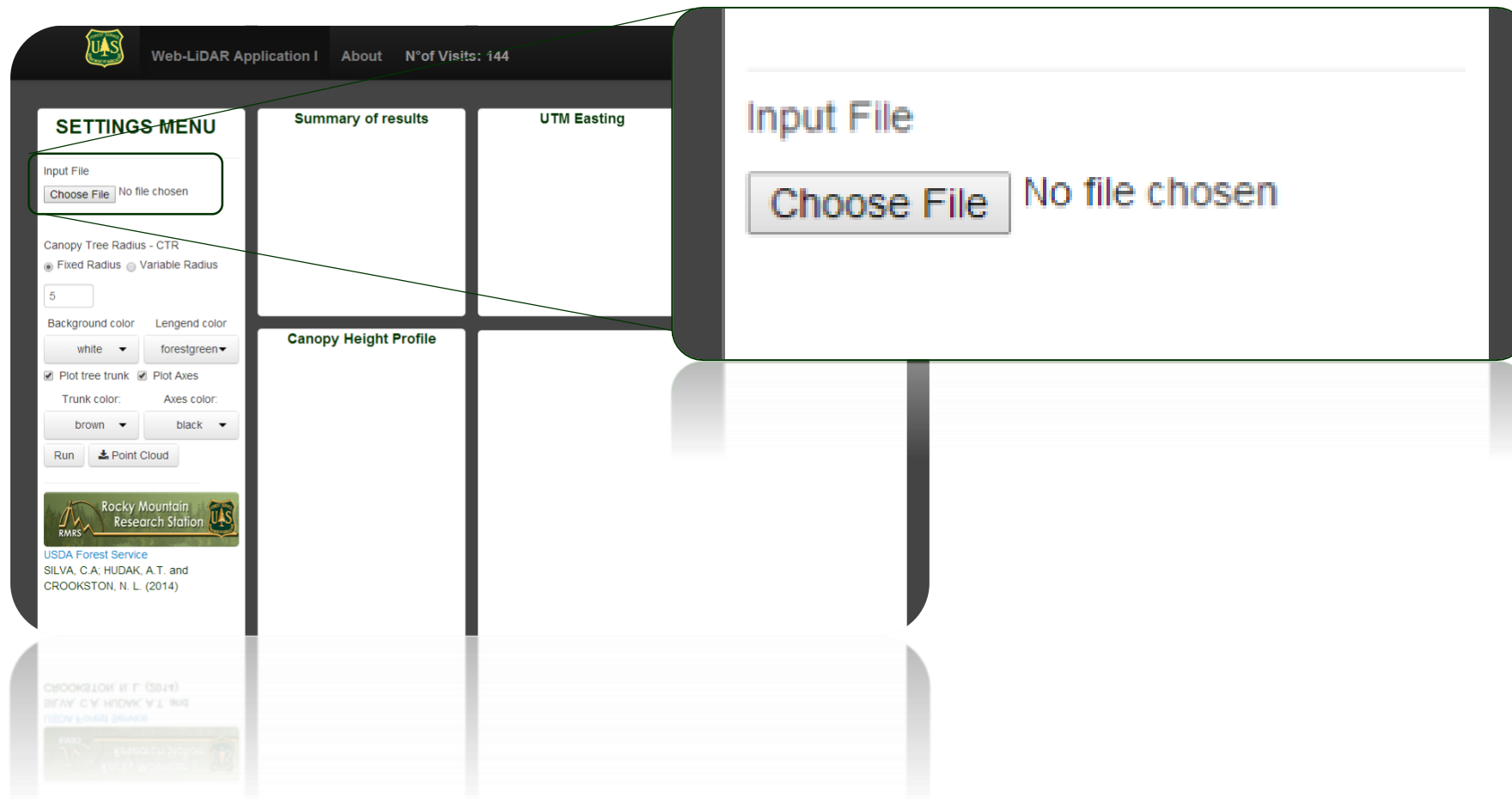
USDA - Rocky Mountain Research Station - RMRS  
SILVA, C.A.; HUDAK, A. T.; CROOKSTON, N. L. (2014)

# 1. How does the algorithm works?

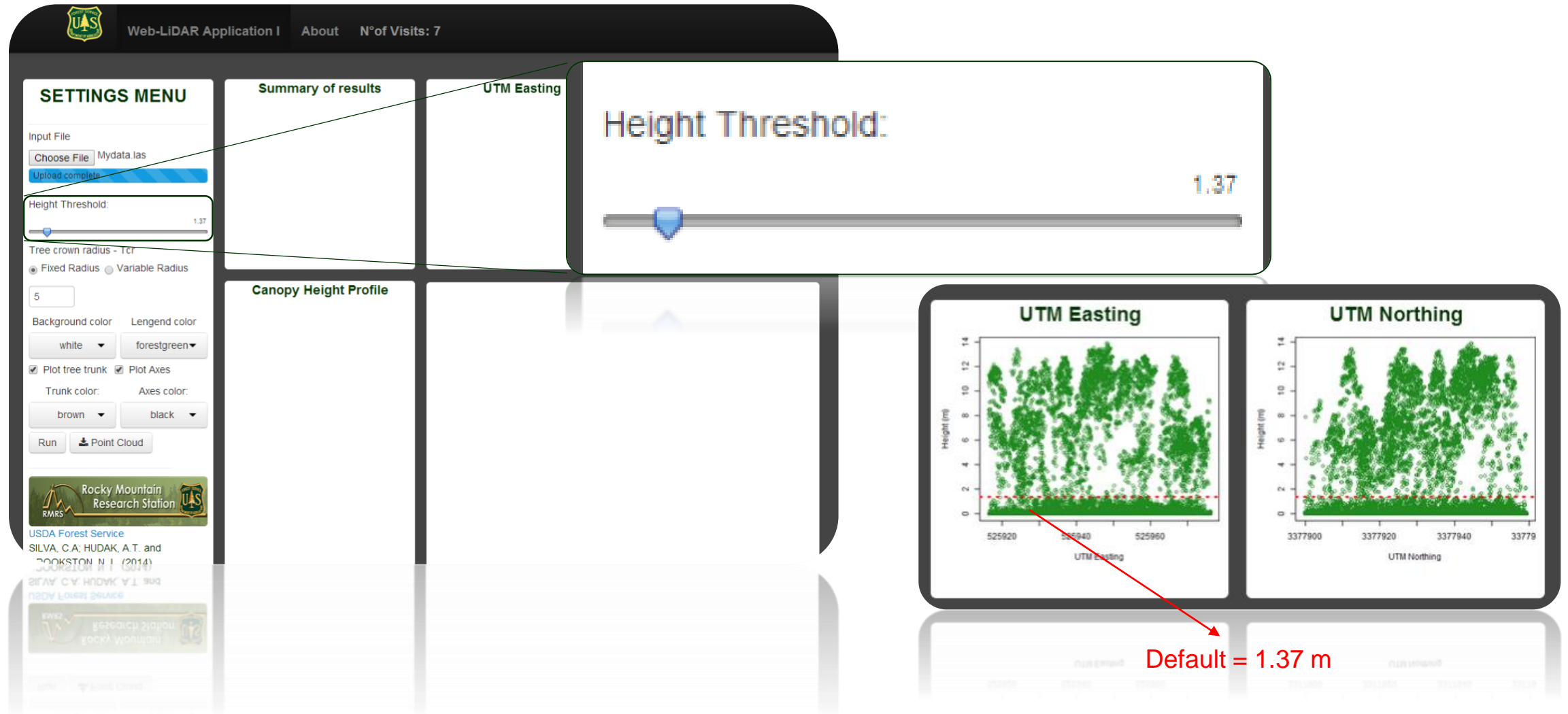




## 2. Input LiDAR data (.las)



# 3. Height Threshold ( m ) parameter



# 4. Tree crown radius ( m ) – Fixed Radius

The screenshot displays the Web-LiDAR Application interface. The top navigation bar includes the UAS logo, the title "Web-LiDAR Application I", and links for "About" and "N° of Visits: 7". The main content area is divided into three panels: "SETTINGS MENU", "Summary of results", and "UTM East".

The "SETTINGS MENU" panel on the left contains the following controls:

- Input File:** A "Choose File" button and a "Mydata.las" file name.
- Upload complete:** A blue button indicating the upload status.
- Height Threshold:** A slider set to 1.37.
- Tree crown radius - Tcr:** Radio buttons for "Fixed Radius" (selected) and "Variable Radius", with a text input field containing the value "5".
- Background color:** A dropdown menu set to "white".
- Legend color:** A dropdown menu set to "forestgreen".
- Plot tree trunk:** A checked checkbox.
- Plot Axes:** A checked checkbox.
- Trunk color:** A dropdown menu set to "brown".
- Axes color:** A dropdown menu set to "black".
- Run:** A button to execute the processing.
- Point Cloud:** A button to download the point cloud.

A callout box titled "Tree crown radius - Tcr" is overlaid on the right side of the interface, showing the selected "Fixed Radius" option and the input value "5".

At the bottom right, a 3D point cloud visualization of a forest canopy is shown. Three individual tree crowns are highlighted with red dashed circles, each labeled with a "2 m" radius, illustrating the fixed radius measurement.

# 4. Tree crown radius ( m ) – Variable Radius

The screenshot displays the 'Web-LiDAR Application' interface. On the left is a 'SETTINGS MENU' with options for 'Input File', 'Tree crown radius - Tcr' (Fixed Radius, Variable Radius), 'Allometric Equation: Tcr = f(ht)' (Deciduous, Pines, Combined, Own), 'Background color', 'Legend color', 'Plot tree trunk', 'Plot Axes', 'Trunk color', and 'Axes color'. The main area shows a 'Summary of results' and 'UTM Easting' section. Below this is a 'Canopy Height Profile' section. A 3D point cloud visualization of a forest is shown at the bottom, with three tree crowns highlighted and labeled with their crown widths: 1.5 m, 2 m, and 2.3 m. A text box on the right side of the interface contains the following text:

Tree crown radius - Tcr

☐ Fixed Radius ☒ Variable Radius

Allometric Equation:  $Tcr = f(ht)$

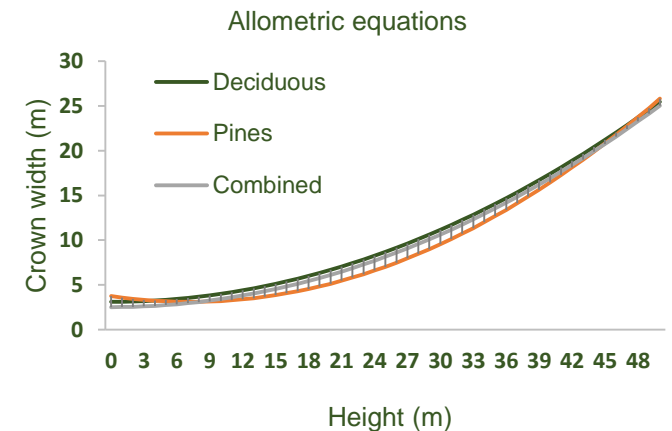
☐ Deciduous ☐ Pines ☐ Combined

☒ Own

|--Inter-----ht-----ht^2-----ht^3--|

The deciduous, pines and combined allometric equations are from Popescu and Wynne (2004).

Popescu, S.C. and R.H. Wynne, 2004. Seeing the trees in the forest: using lidar and multispectral data fusion with local filtering and variable window size for estimating tree height. Photogrammetric Engineering & Remote Sensing 70(5): 589-604.



$$\text{Crown Radius} = (\text{crown width}) / 2$$

# 5. Background and legend color

The screenshot displays the 'Web-LiDAR Application' interface. The top navigation bar includes the 'UAS' logo, the application name, an 'About' link, and a visit count of 144. The main content area is divided into four panels: 'Summary of results', 'UTM Easting', 'UTM Northing', and 'Canopy Height Profile'. On the left, a 'SETTINGS MENU' sidebar contains options for 'Input File' (with a 'Choose File' button), 'Canopy Tree Radius - CTR' (set to 5), 'Background color' (set to 'white'), 'Legend color' (set to 'forestgreen'), 'Trunk color' (set to 'brown'), and 'Axes color' (set to 'black'). A 'Run' button and a 'Point Cloud' download icon are also present. At the bottom of the sidebar, there is a logo for the 'Rocky Mountain Research Station' and a citation for 'USDA Forest Service, SILVA, C.A.; HUDAK, A.T. and CROOKSTON, N. L. (2014)'. A callout box on the right, titled 'Background color' and 'Legend color', shows the selected 'white' and 'forestgreen' options with dropdown arrows. The entire interface is reflected on a surface below it.

# 7. Plot tree trunk and axes

The screenshot displays the 'Web-LiDAR Application' interface. The 'SETTINGS MENU' on the left includes an 'Input File' section with a 'Choose File' button and 'No file chosen' text. Below this is the 'Canopy Tree Radius - CTR' section with radio buttons for 'Fixed Radius' (selected) and 'Variable Radius', and a text input field containing '5'. The 'Background color' is set to 'white' and 'Lengend color' is 'forestgreen'. The 'Plot tree trunk' and 'Plot Axes' checkboxes are both checked. Below these are dropdown menus for 'Trunk color' (set to 'brown') and 'Axes color' (set to 'black'). At the bottom of the settings are 'Run' and 'Point Cloud' buttons. The main content area is divided into four panels: 'Summary of results', 'UTM Easting', 'UTM Northing', and 'Canopy Height Profile'. A callout box highlights the 'Plot tree trunk' and 'Plot Axes' checkboxes and their corresponding color selection dropdowns.

Web-LiDAR Application | About | N° of Visits: 144

### SETTINGS MENU

Input File  
Choose File | No file chosen

Canopy Tree Radius - CTR  
☒ Fixed Radius ☐ Variable Radius  
5

Background color: white | Lengend color: forestgreen

☒ Plot tree trunk ☒ Plot Axes  
Trunk color: brown | Axes color: black

Run | Point Cloud

Rocky Mountain Research Station  
USDA Forest Service  
SILVA, C.A; HUDAK, A.T. and CROOKSTON, N. L. (2014)

Summary of results | UTM Easting | UTM Northing | Canopy Height Profile

☒ Plot tree trunk ☒ Plot Axes  
Trunk color: brown | Axes color: black

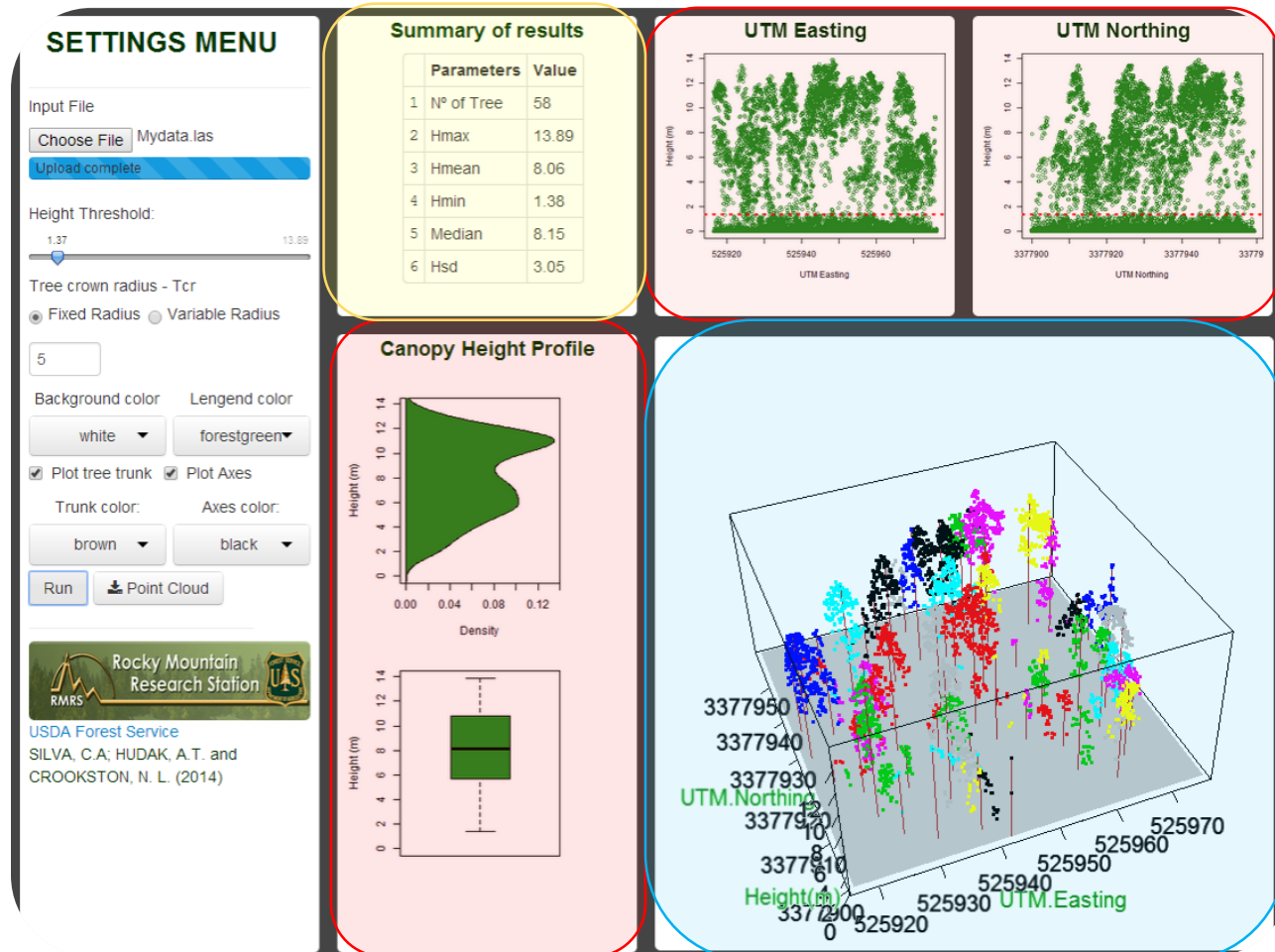
If the checkbox are selected, choose the colors for tree trunk and axes



# 8. Start the LiDAR data processing



## 9. LiDAR data viewer

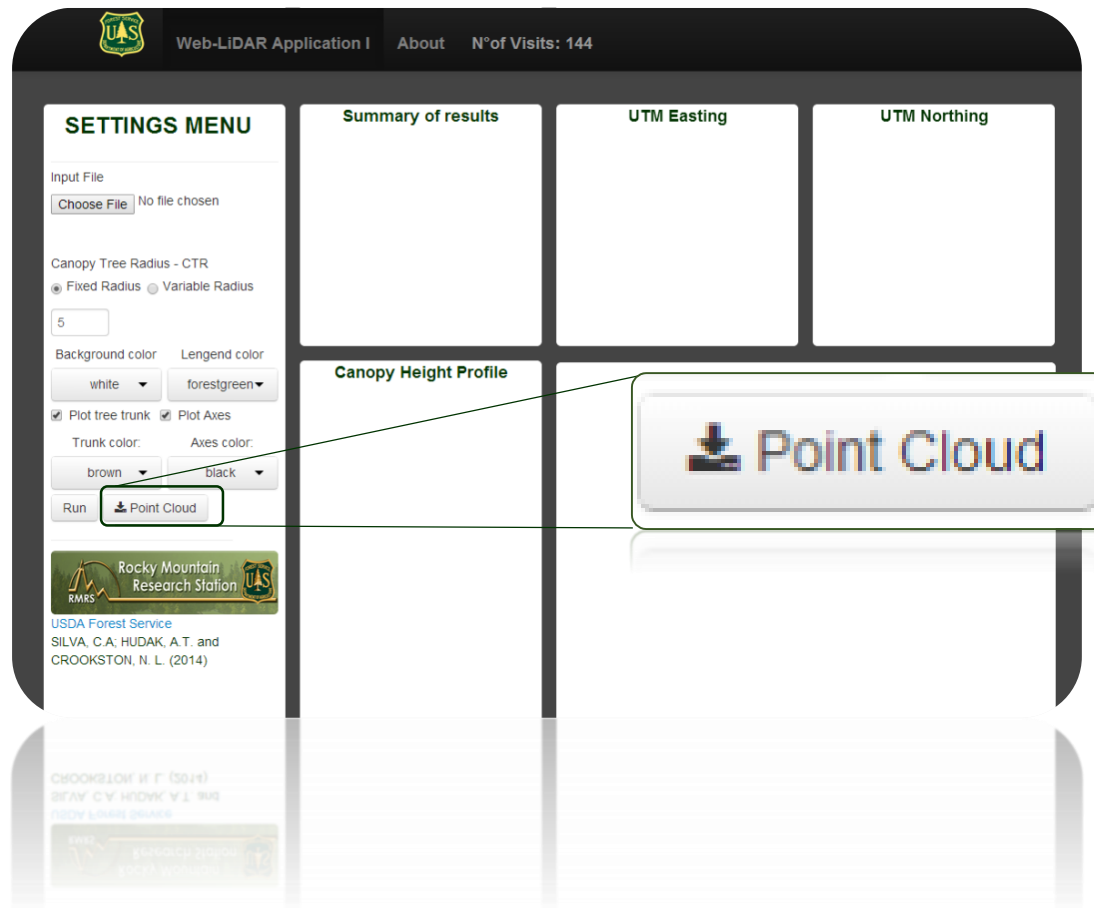


## Summary of the LiDAR Metrics

 Profile viewer of the LiDAR data

3D LiDAR viewer

# 10. Download of the LiDAR data processed



The screenshot shows an Excel spreadsheet titled 'TreesMydata.las2014-02-26 (1) - Excel'. The data is organized into columns: X, Y, Z, gpstime, intensity, return, and NurTreeVec. The data rows show coordinates and values for various points. A green line from the 'Point Cloud' button in the previous image points to this table.

	X	Y	Z	gpstime	intensity	return	NurTreeVec
1	525916.4	3377929	10.67	36008630	53	1	12
2	525916.4	3377929	10.73	36008875	76	1	12
3	525916.5	3377930	8.11	36008630	82	1	12
4	525916.5	3377931	8.48	36008875	28	1	12
5	525916.5	3377929	10.77	36008875	40	1	12
6	525916.5	3377930	7.71	36008630	37	1	12
7	525916.5	3377928	11.31	36008630	78	1	12
8	525916.5	3377927	11.1	36008630	68	1	12
9	525916.5	3377927	11.26	36008875	73	1	12
10	525916.6	3377927	8.03	36008875	73	1	12
11	525916.6	3377932	8.52	36008630	9	1	12
12	525916.6	3377931	9.09	36008630	100	1	12
13	525916.7	3377929	10.4	36008875	54	1	12
14	525916.7	3377927	8.26	36008875	37	1	12
15	525916.7	3377926	7.21	36008875	75	1	12
16	525916.7	3377929	11.14	36008875	56	1	12
17	525916.7	3377927	11	36008875	79	1	12
18	525916.7	3377930	11.35	36008630	87	1	12
19	525916.8	3377928	11.13	36008630	8	1	12
20	525916.8	3377930	11.39	36008875	88	1	12
21	525916.8	3377927	7.23	36008875	72	1	12
22	525916.8	3377932	8.53	36008875	33	1	12
23	525916.8	3377926	6.26	36008875	45	1	12
24	525916.8	3377932	8.27	36008875	10	1	12
25	525916.9	3377926	6.3	36008630	85	1	12
26	525916.9	3377935	5.57	36008630	2	1	28





### **Acknowledgement:**

Funding to support Carlos Silva's development of Web-LiDAR and its underlying functions was provided through a grant (RC-2243) from the Department of Defense Strategic Environmental Research and Development Program: Patterns and processes: monitoring and understanding plant diversity in frequently burned longleaf pine landscapes. J. O'Brien, PI; R. Mitchell, A. Hudak, L. Dyer, Co-PIs.

The airborne lidar data provided as an example dataset is from a longleaf pine forest at Eglin AFB. It's collection was funded by a grant (11-2-1-11) from the Joint Fire Science Program: Data set for fuels, fire behavior, smoke, and fire effects model development and evaluation—the RxCADRE project. R. Ottmar, PI; multiple Co-Is.

### **Objective:**

Web-LiDAR was developed to support lidar-based forest inventory and management at Eglin Air Force Base (AFB), Florida, USA. However, it has general applicability to other forests in other ecosystems, and we encourage users to test it broadly.

**Carlos\_engflorestal@outlook.com**

