

Protocol for validating hypsometer measurements of crown dimensions

Taking crown dimension measurements with the laser hypsometer has many advantages. However, one disadvantage is that one is sometimes unsure if the device is measuring the intended section of the crown. Thus, for a sub-sample of hypsometer-measured crowns, we measure some basic crown dimensions (max and perpendicular crown widths, height of first branch, height of base of crown, and tree height) using more traditional methods.

A good rule of thumb is to take one validation measurement of a tree crown per day during the campaign. A good way to randomize this would be to measure the n^{th} tree of every day (e.g. the 3rd tree measured every day). It would also be important to validate measurements of particularly large, small, or otherwise uncommon crown sizes. Avoid taking measurements of trees whose stems are very inclined. This makes measurement more complicated, and because these are just validation measurements, we do not have to be overly concerned about randomization.

Make sure to record whether inclinometer angles are positive or negative. Negative angles point downwards (if you are on a hill looking down), positive angles point upwards (looking up to a treetop).

1. Identify the axis of greatest width of the tree crown (the major axis). One person walks to one edge of this axis, and using the inclinometer at 90°, places herself directly under the outermost point of that axis.
 - a. Another person takes a tape measure, one end held by the first person standing under the crown edge, and walks to the far end of the long axis of the crown. Again, placing herself directly under the furthest edge of the crown axis using the inclinometer.
 - b. Record the length of the taught tape measure.
2. Identify the axis of greatest width of the tree crown that is perpendicular to the axis just measured (the minor axis). Perform the same steps as above to measure the length of that semi-major axis.
 - a. Also be sure to record at which length along the major axis the minor axis crosses the major axis, and at which length along the minor axis the major axis crosses.
3. Step back to a distance where the base and first branch of the crown are visible. Measure your distance to the point directly below the base of the crown with a tape measure. The tape measure must be level during this measurement (take special note of this if you are on a slope).
 - a. Using the inclinometer, measure the angle from your eye to the base of the crown and to the first branch. Record these two values.
 - b. Again using the inclinometer, record the angle from your eye to the base of the tree (where the stem meets the ground).
4. Step back to a distance where the top of the tree crown is the most visible possible. Repeat the process in #3 to measure the inclination to the top of the tree crown, to the base of the tree, and the distance to the tree.
 - a. If the top of the tree crown is significantly displaced from the base of the tree, then measure the distance to the point directly below the treetop in addition to the distance to the tree stem.
5. Take one or more pictures of the tree and crown, preferably with an object to scale in the frame (e.g. a person), and record the picture number in the data book. These are very useful for validating measurements in the future.