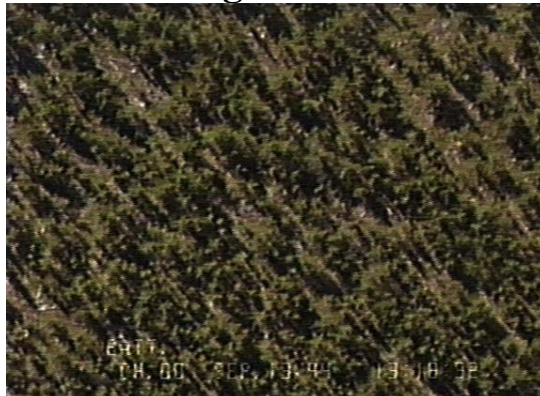


The following images and graphs illustrate some typical outputs from an airborne canopy Lidar. The NASA SLICER instrument collected the data over Boreal sites in Canada in 1996. The first images shows three sites which were chosen for their contrasting structure. The first is an immature Jack Pine plantation, the second, a mature plantation of Jack Pine and the third is a mature Aspen stand.

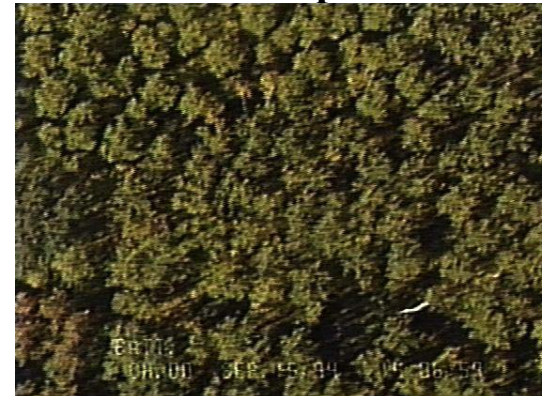
Young Jack Pine



Old Jack Pine

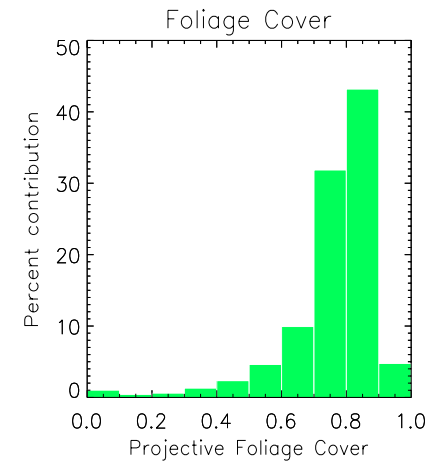
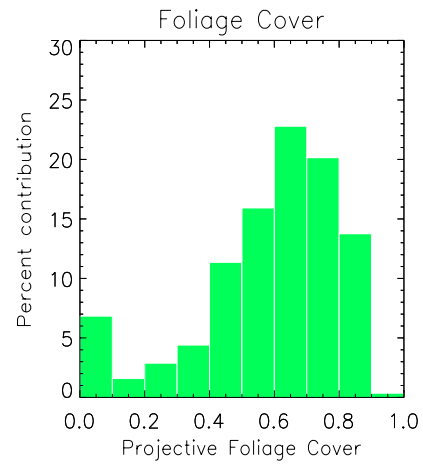
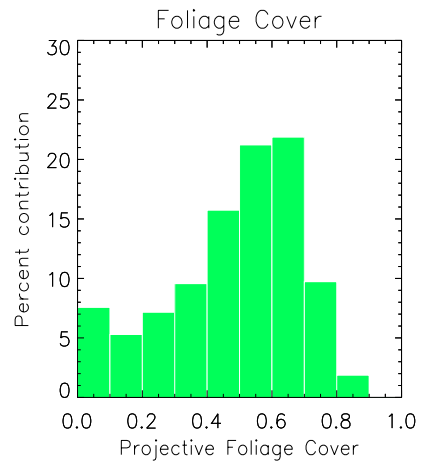
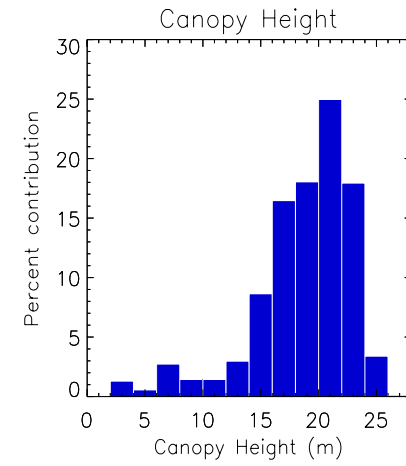
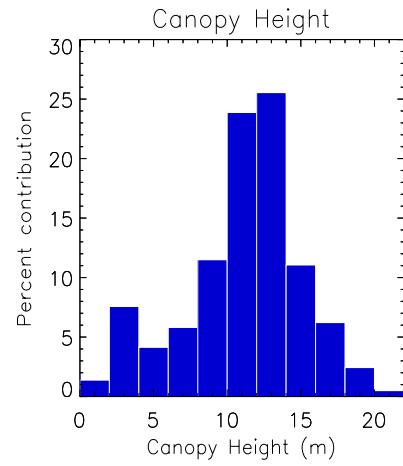
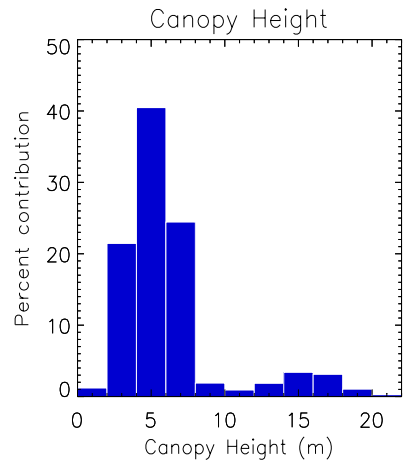


Old Aspen

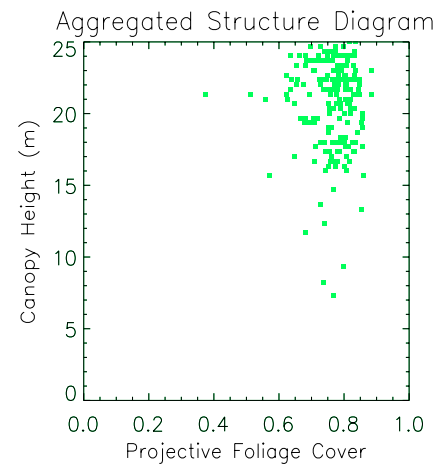
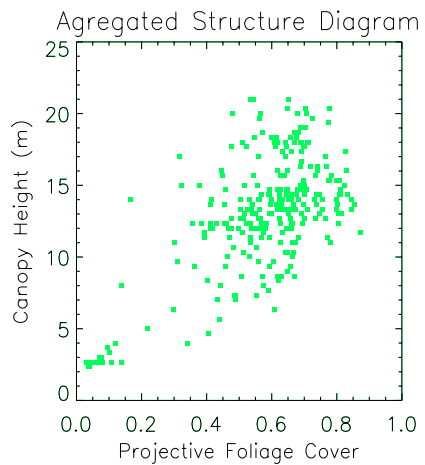
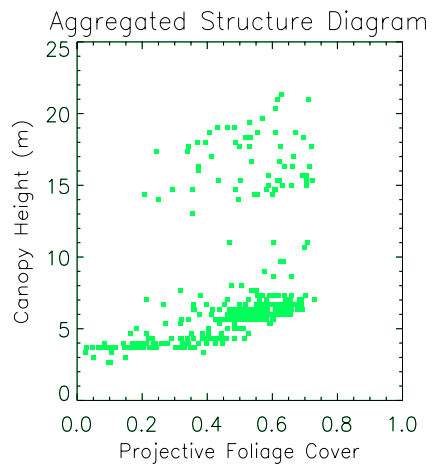
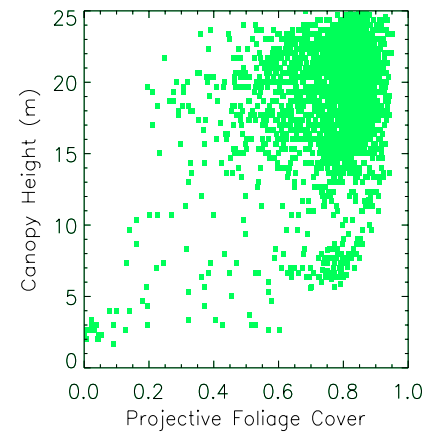
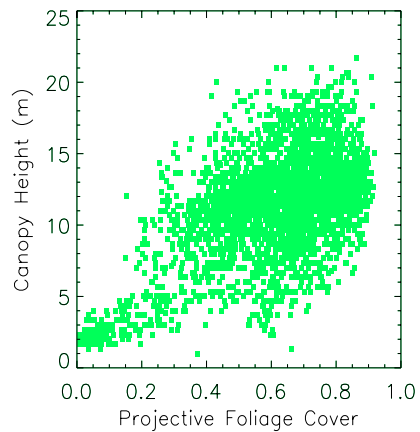
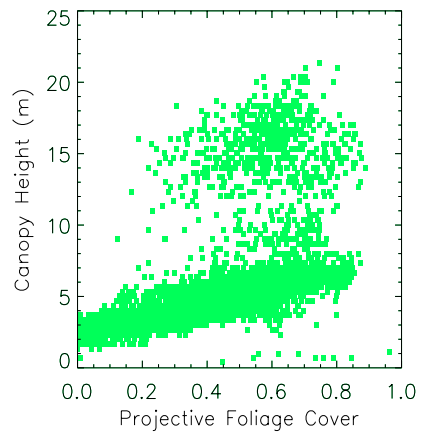


Two important structural measures that are easily obtained from canopy Lidar data are canopy height and fractional cover. Canopy height is directly measured from the Lidar waveform by identifying the ground return and subtracting its altitude from that of the first recorded return (the top of the canopy). The relative amount of light reflected from the canopy compared with the ground leads to a measure of canopy cover.

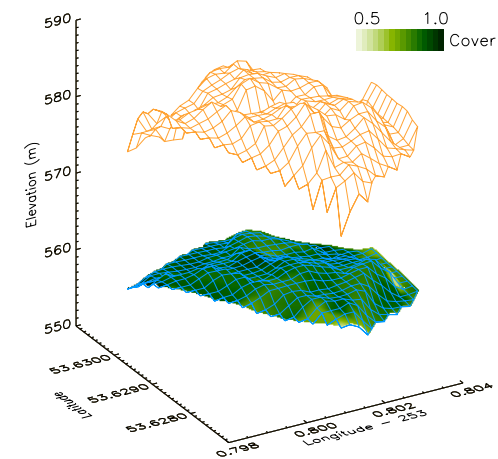
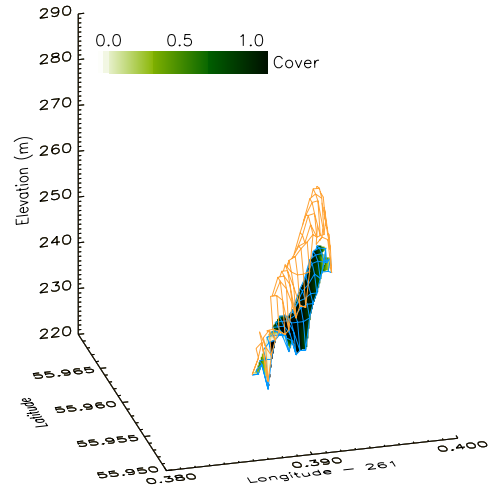
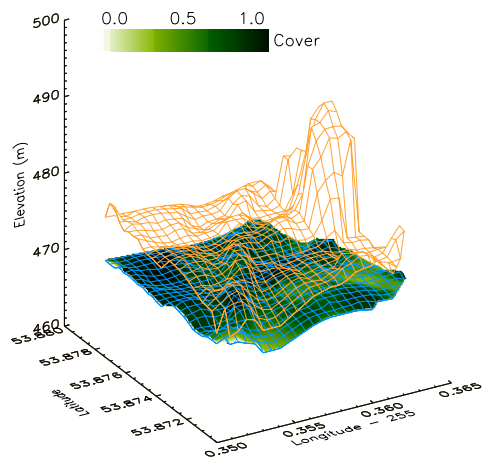
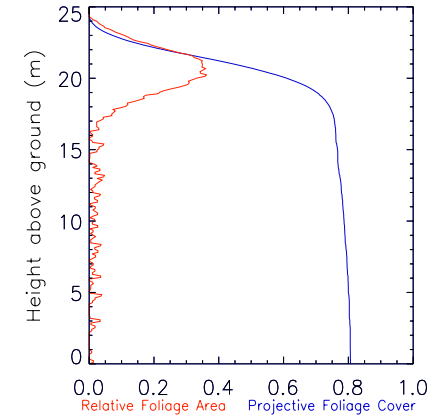
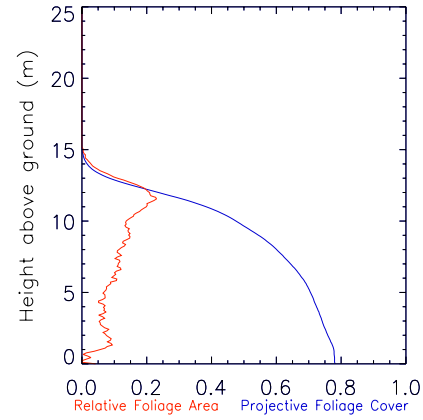
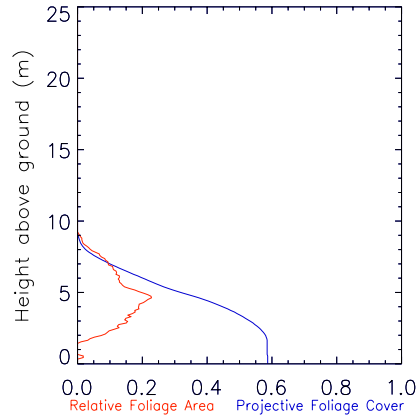
The following histograms show the distribution of heights and fractional cover measured by each Lidar footprint (10m diameter) for the three sites. The contrast between the sites is immediately evident. This is demonstrated more graphically by a plot of cover against height - a vegetation structure plot. Clusters of points in these plots show areas of uniformity in the forest. Points with low cover and height are due to gaps in the canopy. The size of such gaps can be estimated by aggregation of Lidar data over larger areas. In the second group of structure plots, the data from neighbouring Lidar shots (3 shots x 3 shots) have been grouped. Note that the distinctly different group of tall, high cover points in the Young Jack Pine site are still separate from the main group. This indicates an area of taller, denser forest, rather than isolated tall trees within the main forest. Similarly, there is a group of low height and cover points in the Old Jack Pine which remains when the data are grouped. This implies large clear areas (such as roads) rather than isolated tree falls.



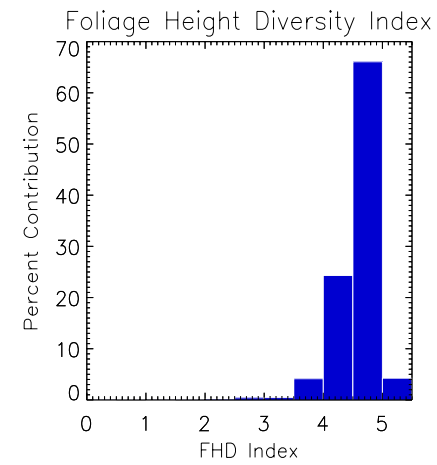
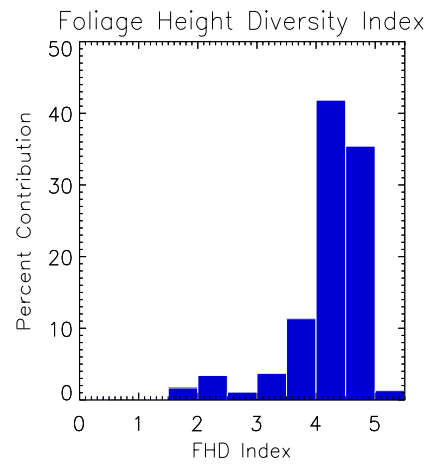
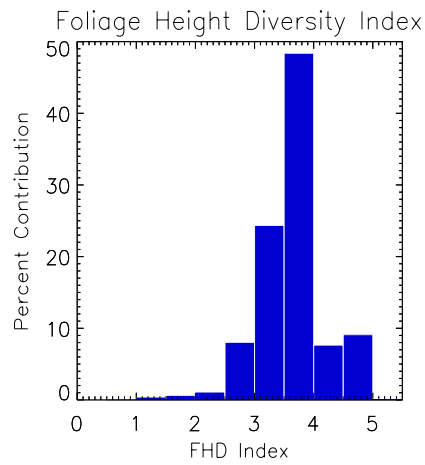
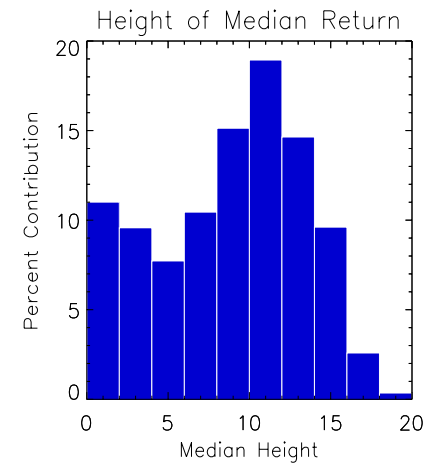
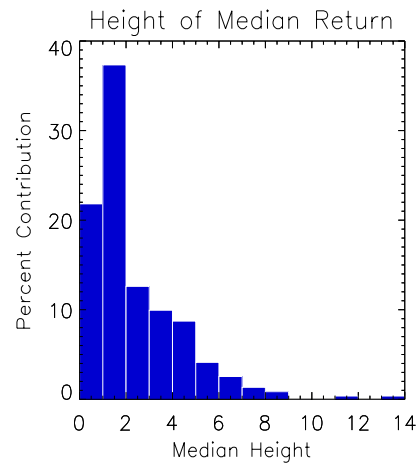
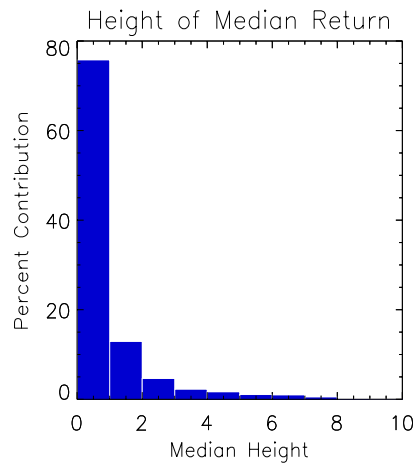
Vegetation Structure Diagrams



Example Foliage profiles (red) and cumulative projective foliage cover (blue).



Canopy height (orange) overlaid above a digital elevation model (blue). The ground is also colour coded by total fractional vegetation cover (green shades). Note that the immature Jack Pine stand (left) is adjacent to an area of taller forest - the group of separate points highlighted in discussion of the structure plot above.



A variety of height measure can be derived from canopy Lidar data. For example the height of median return (the height at which half the returned energy came from above and half below) is a combined measure of cover and height. The foliage height diversity index is a measure of layering in the canopy and is used as a measure of biodiversity potential (particularly for birds).