Introduction

An important issue in forest management planning is stand delineation and area estimation. Inaccuracies in defining homogeneous stands may adversely affect inventory analysis and forest planning models through standard available acreage constraints, adjacency, and green-up requirements for forest certification. Inaccuracies in delineating homogeneous stands and their polygon size may result in sub-optimal solutions for specified forest management goals. The goal of this study is to delineate stand boundaries using IKONOS and Quick Bird satellite platforms and evaluate their impact on forest planning model solutions and activity schedules. An additional goal for this study is to evaluate a protocol for developing a semi-automated system for stand delineation. This additional goal was motivated by previous research that showed significant variation in stand delineation between interpreters.

Methods

Image analysis used eCognition v3.0 (Definiens GmbH, Munich, Germany) software to search for initial forest polygons greater than than 10 acres. Once found, segmentation parameters (scale, color, shape, compactness, and smoothness) were adjusted iteratively to delineate stand polygons. The next step involved area estimation of the identified stand polygons.

Results

Preliminary image segmentation results from eCognition v3.0 show minor differences between satellite imagery types.

<table>
<thead>
<tr>
<th>Type</th>
<th>Total Forested Acreage</th>
<th>Stands Identified</th>
<th>Pine</th>
<th>Hdwd</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>IKONOS</td>
<td>6,682</td>
<td>104</td>
<td>75</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Quick Bird</td>
<td>6,773</td>
<td>100</td>
<td>70</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>GIS</td>
<td>7,194</td>
<td>212</td>
<td>161</td>
<td>14</td>
<td>39</td>
</tr>
</tbody>
</table>

Total Net Present Value (NPV) for types using the preliminary forest planning model:

- IKONOS: $15,399,217, 53 stands harvested
- QuickBird: $14,796,661, 52 stands harvested
- Existing GIS: $15,776,681, 96 stands harvested

Discussion

The greatest difference in the preliminary segmentation results are the number of total stands identified between the existing GIS and the segmented images. This is a result of small stands (less than 10 acres) being identified on the existing GIS. NPV differences in imagery types and existing GIS is relatively small, however future iterations of segmentation parameters are expected to differ more significantly. Also, the number of stands harvested was similar between the IKONOS and QuickBird imagery because of the similarities in forest type distribution and location.

Future Work

Segmentation of both the IKONOS and QuickBird imagery will result in approximately 160 polygon layers. Because of eCognition creating large (over 100 acres) forested areas, each polygon layer will be split according to a specified minimum and maximum area. This will be useful in simulating even-age management harvest sizes to various forest certification requirements. Each of these layers must be given forest attribute codes and then be input into the forest planning model. Also, green-up period lengths of 1, 3, and 5 years will be analyzed to determine impacts of spatial constraints. Once this is completed, the differences of objective function values from the imagery types and existing GIS will be further evaluated.