Measurement activities were focused in the Oak Creek area of OSU's McDonald Forest. Two OSU students were hired to GPS feature locations and to identify tree and plant species during summer and fall 2008. Principal investigator Michael Wing also participated in field data collection during this time, including taking GPS measurements, digital images, and digital video of selected features.

All told, nearly 1,300 features in the Oak Creek area were identified (species or object type) and mapped with GPS. All of these features can be viewed and examined on the Virtual Forest Internet site. In addition to identifying and mapping, video imagery was taken from more than 300 features. Over 250 trees, shrubs, and flowers were identified, GPS-located, and digitally photographed. Other features, including roads, culverts, forest views, and a water flume were also identified, located, and photographed. GPS locations and high resolution video imagery, accompanied by a sound recording of species identification, was collect from 38 representative trees and shrubs. The imagery creates a panoramic perspective of these features. In addition, ten panoramic videos were taken within an area that was heavily used for tree and shrub mapping and identification.

In addition, 481 trees were species-identified and GPS-located within a dense forest stand. The student inventory team also located and identified over 500 trees and shrubs within a stand on the western portion of the Oak Creek area. These features were not included at the final Virtual Forest Internet site due to database size limitations but are part of continuing efforts to assess LiDAR effectiveness in identifying ground features in forested areas.

All features that were GPS located were converted into GIS databases. Species and other identification information, as well as any related digital photographs or imagery, was associated with the GIS databases.

LiDAR data acquisition was funded by a separate grant and contained an average density of eight LiDAR measurements per square meter. The LiDAR data were collected during April 2008 and became available in August 2008. A ground surface model of the Oak Creek area was generated from the LiDAR data and shows ground elevation. A highest-return LiDAR database was created and gives a representation of forest canopy cover. A LiDAR intensity image, produced from the near-infrared wavelength contained within LiDAR pulses, was generated and approximates a high-resolution black and white photograph.

The LiDAR databases were used to create road, stream, and trail spatial databases of the Oak Creek area. The existing GIS databases of roads and trails were used as initial templates in this process. The high resolution LiDAR databases very clearly demonstrated that the existing databases were not accurate spatial representations of ground features. The LiDAR ground surface model was used within GIS-based hydrologic analysis functions to simulate the flow of water over the Oak Creek area. The resulting drainage output was to create a detailed spatial database of major streams within the Oak Creek area.

The spatial and digital imagery databases were integrated into a WWW-based software package (ESRI's ArcServer) for Internet access by interested parties. The Internet site is named the Virtual Forest and is

available to all with an Internet connection and WWW browser. To economize data storage and access speeds, the data representing the trees and shrubs of the western portion of the Oak Creek area are not currently included in the Virtual Forest primary site. This allows the accompanying LiDAR databases, which are substantial in size, to be reduced to a more modest area. Even with this reduction, the databases at the Virtual Forest site are 600 GB in size.

The Virtual Forest allows users to view the mapped locations of GPS located features and to use a mouse to click on a tree or shrub location for more information. For each mapped feature, an information box opens that identifies the feature, and provides links to the high-resolution photographer and imagery, if it exists for that feature. The databases within the Virtual Forest are separated into different digital layers, allowing users to choose which spatial databases they want to view. The database layers are separated into trees, shrubs, views, roads, trails, streams, and other feature types. Layers that contain imagery are also further separated by whether the imagery is a digital photograph or video. In addition, individual data layers are provided for the LiDAR ground surface, highest return, and intensity data. These layers are provided as one meter resolution databases. In addition, a color digital orthophotograph at half-meter resolution was obtained from the Oregon Imagery Explorer at OSU and is also available at the Virtual Forest site.

The separation of database layers enables users to quickly identify the features for which imagery is available and to focus their exploration of databases. The database separation is also convenient for simplifying the viewing perspective that appears in the primary map interface.

The Virtual Forest has only recently been made available on the Internet so there has not been sufficient time to judge its use by interested parties. Nonetheless, the Virtual Forest will provide a data resource to two GIS-oriented courses at OSU within the College of Forestry. A manuscript describing the Virtual Forest and intended for publication at a peer-reviewed journal is anticipated during summer 2009. Another manuscript that describes the ability of the high resolution LiDAR data to accurately locate and describe tree characteristics is also intended for summer 2009. This manuscript will draw heavily upon the data collected by the student inventory team.

The Virtual Forest Project WWW site: http://www.cof.orst.edu/wingm/NWACC/
The Virtual Forest can be visited at: http://meridian/VirtualForest/.

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