

Forest Biomass and Leaf Area Density Profiles from Multialtitude Radar Interferometry and Imaging Spectroscopy

R. N. Treuhaft (Jet Propulsion Laboratory, California Institute of Technology,
Pasadena, California)

G. P. Asner (Carnegie Institute, Stanford University, Stanford, California)

B. E. Law (Oregon State University, Corvallis, Oregon)

and S. Van Tuyl (Oregon State University, Corvallis, Oregon)

One of the principal objectives of forest remote sensing is determining the component of the global carbon budget affected by forest biomass sequestration and change. Vegetation structure, as revealed by density profiles, is a key indicator of aboveground biomass and biomass change due to natural or anthropogenic disturbance. This paper tests the hypothesis that biomass is sensibly related to leaf area density (LAD), and evaluates the degree to which LAD can determine biomass. The LADs in this paper result from multialtitude radar interferometry from the NASA Airborne Synthetic Aperture Radar (AIRSAR) and hyperspectral optical data from the NASA Airborne Visible and Infrared Imaging Spectrometer (AVIRIS). AIRSAR was flown in interferometric mode, with vertical polarization, over Central Oregon at three different altitudes, 8 km, 5.6 km, and 2 km in July 2000 at C-band (wavelength=5.6 cm). AVIRIS, with spectral channels spanning 500-2500 nm, was flown in July 2000 and June 1999. Multiple baselines are required to obtain the unnormalized vertical profile of the product of scatterer number density and backscattering amplitude squared. Plausible assumptions relate the profile of this product to the unnormalized leaf area density as a function of height. Because radar interferometric sensitivity is proportional to the baseline length over the radar altitude, multialtitude interferometry with a single baseline is equivalent to multiple baselines used for profiling. The relative profiles are normalized by the leaf area index determined from hyperspectral imaging with AVIRIS. This paper relates the biomass of 10 stands in Central Oregon to their LAD profiles and suggests biomass algorithms based on LAD and other measures of forest structure.