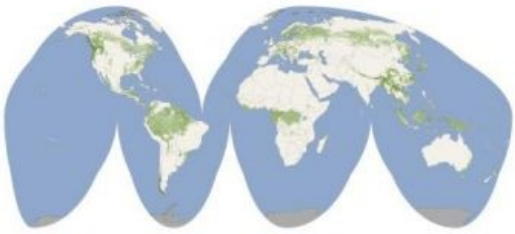
Map of Global Forest Heights



Scientists have produced a first-of-its kind map of the height of the world's forests by combining data from three NASA satellites. The map will help scientists build an inventory of how much carbon the world's forests store and how fast that carbon cycles through ecosystems and back into the atmosphere.

Maps of local and regional forest canopy have been produced before, but the new map is the first that spans the entire globe using one uniform method. The map was based on data collected by NASA's Terra and Aqua satellites, along with the Ice, Cloud and land Elevation Satellite, or ICESat. Michael Lefsky, a remote-sensing specialist from Colorado State University in Ft. Collins, produced the final product. Lefsky describes his results in a journal paper to be published next month in Geophysical Research Letters.

The new map shows the world's tallest forests are clustered in North America's Pacific Northwest and portions of Southeast Asia. Shorter forests are found in broad swaths across northern Canada and Eurasia.

The primary data Lefsky used was from a laser technology called lidar on the ICESat. Lidar can capture vertical slices of forest canopy height by shooting pulses of light at the ground and observing how much longer it takes for light to bounce back from the surface than from the top of the forest canopy. Since Lidar can penetrate the top layer of forest canopy, it provides a detailed snapshot of the vertical structure of a forest.

"Lidar is unparalleled for this type of measurement," Lefsky said. "It would have taken weeks or more to collect the same amount of data in the field by counting and measuring tree trunks that lidar can capture in seconds."

Lefsky based the map on data from more than 250 million laser pulses collected during a seven-year period. Because each pulse returns information about a tiny portion of the surface, Lidar offered direct measurements of only 2.4 percent of the Earth's forested surfaces. To complete the map, Lefsky combined the Lidar data with information from the Moderate Resolution Imaging Spectroradiometer (MODIS), an instrument aboard NASA's Terra and Aqua satellites. MODIS observes a broad swath of Earth's surface, even though it does not supply the vertical profile.

The new results show that temperate conifer forests -- which are extremely moist and contain massive trees such as Douglas fir, western hemlock, redwoods, and sequoias -- have the tallest canopies, soaring above 131 feet. In contrast, boreal forests dominated by spruce, fir, pine, and larch had canopies typically less than 66 feet. Relatively undisturbed areas in tropical rain forests were about 82 feet tall, roughly the same height as the oak, beeches, and birches of temperate broadleaf forests common in Europe and much of the United States.

Measuring canopy height has implications for efforts to estimate the amount of carbon tied up in Earth's forests and for explaining what absorbs 2 billion tons of "missing" carbon each year. Humans release about 7 billion tons of carbon annually, mostly in the form of carbon dioxide. Of that, 3 billion tons end up in the atmosphere and 2 billion tons in the ocean. It's unclear where the remaining 2 billion tons of carbon go, although scientists suspect forests capture and store much of it as biomass through photosynthesis.

The new forest height map is a step toward a global map of all above-ground biomass. Sassan Saatchi, senior scientist at NASA's Jet Propulsion Laboratory in Pasadena, Calif., already has started combining the height data with forest inventories to create biomass maps for tropical forests. Global biomass inventories will eventually be used to improve climate models and guide policymakers on carbon management strategies.

The next generation lidar measurements of forests and biomass, which will improve the detail of the map considerably, could come from a planned NASA satellite mission, called the Deformation, Ecosystem Structure and Dynamics of Ice project. It is slated to launch no earlier than 2017.