Carbon Storage by Tree Root Biomass

This map estimates the kilograms of dry carbon stored per square meter in below-ground biomass in each 12-digit hydrologic unit (HUC). Biomass below ground includes tree root biomass.

Why is carbon storage important?

Carbon is one of the most abundant elements on Earth and forms the basic building blocks of most living organisms. Carbon makes up half of the dry weight of tree biomass. Because trees are capable of storing atmospheric carbon as biomass, carbon is removed from the atmosphere, contributing to a more stable climate. Carbon that is captured by forests can be stored for centuries, though there is a risk of carbon release due to disturbance. Tree roots contribute to below-ground carbon storage, especially soil organic matter which is considered to be the most stable surface reservoir for carbon.

Carbon comes in many forms, though carbon in the form of CO_2 is the dominant greenhouse gas (GHG) released into the atmosphere as a result of human activities.[1] The atmospheric concentration of CO_2 has increased by almost 40% since the start of the industrial revolution in the middle of the18th century.[2] Increasing levels of atmospheric CO_2 and other greenhouse gases (e.g., methane, chlorofluorocarbons, and nitrous oxides) are thought to significantly contribute to an increase in atmospheric temperatures by trapping certain wavelengths of heat in the earth's atmosphere. Though several gases contribute to the greenhouse effect, CO_2 is estimated to be responsible for 80% of the current increases in climate forcing due to all GHGs since 1990.[3]

Climate change refers to any significant change in measures of climate (e.g., temperature, precipitation) that occurs over an extended period (e.g., decades).[4] This change can be due to natural factors, human activities, or a combination of the two. In recent history, the increase of GHGs such as CO_2 has played a major role in recent warming trends and observed changes in climate.[4] The most recent decade was the hottest in recorded U.S. history and extreme weather events, such as heat waves and floods, have increased in frequency and intensity.[5] The U.S. has also experienced wildfires, droughts, increases in surface-water temperatures, more frost-free days and heavy downpours, more frequent and intense winter storms, and sea level rise; these changes can directly and indirectly affect human health in a number of ways.[5]


Photo: USFWS, Oklahoma

Above- and below-ground vegetation are important for carbon capture and storage. Below ground roots and tree leaf litter contribute to soil carbon storage.[6] Carbon can remain stored in soils for millennia or for only a short time, depending on several factors such as climatic conditions, natural vegetation, soil texture, and drainage.[6] By fixing carbon during photosynthesis and storing it as biomass, growing trees act as a sink for CO_2. The storage of carbon by trees, including in roots that are below ground, is important for maintaining a stable climate.

How can I use this information?

The map, Carbon Storage by Tree Root Biomass, helps users identify how much carbon is being stored by all of the trees within a 12-digit HUC. This information can be used to determine areas with a high or low potential for carbon storage. By combining this map with other EnviroAtlas maps, users can locate areas where multiple benefits such as increased storage, decreased pollutant input to streams with riparian buffers, flood attenuation, and habitat connectivity might be located.

EnviroAtlas also includes data on carbon storage in tree biomass, or above-ground biomass, for each 12-digit HUC in the contiguous United States. Other EnviroAtlas community maps illustrate carbon storage and carbon sequestration in tree biomass. The community maps display the data summarized by census block groups.

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How was the data for this map created?

This map was generated using ArcView 3.3 in conjunction with the 2000 National Biomass and Carbon Dataset (NBCD2000) and high resolution (1:24,000 or higher) National Hydrography Data (NHD) for stream lines and water bodies. The NBCD dataset is a high-resolution (30 m), baseline estimate of basal area-weighted canopy height, above-ground live dry biomass, and standing carbon stock for the conterminous United States. Below-ground carbon storage in tree roots is estimated as a proportion of total above-ground biomass carbon. For EnviroAtlas, these data were aggregated to the 12-digit HUC level.

What are the limitations of these data?

The metrics generated from combining these data sets are an estimation of carbon storage based on the best available data. The NBCD estimate of above-ground biomass is based on a modeling approach that combines classification of satellite imagery and the USDA Forest Service Forest Inventory and Analysis data; this process of classifying imagery into standing biomass estimates is not 100% accurate. Therefore below-ground root biomass carbon, which is estimated from above-ground biomass, will also contain these inaccuracies. These data should be used to inform further investigation.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. Metric values for individual pixels may be obtained from the New Mexico State University Center for Applied Spatial Ecology. SWReGAP and GAP data can be accessed through their respective websites.

Where can I get more information?

There are numerous resources on the importance of biomass and carbon storage; a selection of these resources is listed below. For more information about the NBCD data, please visit the Woods Hole Research Center website. Visit the USGS NHD website to learn more about the National Hydrography Data. For additional information on how the data were created, access the metadata for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

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