Average Annual Precipitation

This EnviroAtlas national map estimates the average annual precipitation from 1981–2010 in inches/year within each 12-digit hydrologic unit (HUC). It is based on the Parameter-elevation Regressions on Independent Slopes Model (PRISM) developed by the PRISM Climate Group at Oregon State University.

Why is annual precipitation data important?

Average annual precipitation amount is one of the major attributes characterizing the climate and associated ecosystem types and habitats of an area of interest. Precipitation amount affects a region's stream density, water availability, land cover type, and agricultural productivity. For example, in the Great Basin, average annual precipitation of 13 inches/year is indicative of a semi-arid climate with a desert shrub or sagebrush land cover. Great Basin sagebrush habitats support a characteristic, associated group of plant and animal species representative of the ecoregion.

Historically, precipitation maps were drawn using isolines (lines connecting equal points) connecting rain gauges reporting equal average annual precipitation amounts. Isoline precipitation maps were a generalized estimation of precipitation using available data. Maps of this type were limited by the density and availability of gauging stations; isoline maps may not accurately capture spatial and temporal variability or the full effects of elevational changes on average annual precipitation.

Over the last several decades, with the development of computer mapping, precipitation mapping has evolved to incorporate models of expected topographic variations in precipitation. This EnviroAtlas map of average annual precipitation for the conterminous U.S. uses the PRISM model that combines weather station data, elevation data from a digital elevation model, and regression equations to predict precipitation for each grid cell in the digital elevation model. Station observations used in the regressions are weighted by factors such as distance, elevation, atmospheric vertical layering, aspect, and proximity to a coastline.[1]

Of the many applications of precipitation data, those most pertinent to EnviroAtlas surround landscape character, surface water availability, and agricultural productivity. With historical precipitation data, researchers may search for long term trends in average annual precipitation relative to a region's characteristic climate and surface water availability. Results of a study of precipitation trends during the 20th century found a pattern of increased rainfall and streamflow in the eastern half of the nation and decreased streamflow in the West beginning in the 1970s.[2]

The historical changes in precipitation found in the eastern and western U.S. are of interest to climate change research. Long term precipitation data is necessary to model future climate scenarios. Historical and current precipitation data from various sources feeds climate models that project global and regional rainfall amounts and distribution into the future.[3] Studies have found that regional increases in precipitation amount and intensity are related to increases in temperature over recent decades. Atmospheric water-holding capacity increases by 7% with each 1° C increase in temperature and storms, supplied with more moisture, tend to increase in intensity.[4] There is evidence of increasing intensity in rainfall events in the U.S. over the last several decades.[4,5]

How can I use this information?

This EnviroAtlas national map, Average Annual Precipitation, depicts average annual rain and snowfall for the time period 1981–2010 in inches per year summarized by 12-digit HUC. The map is a modification of the PRISM map developed by the PRISM Climate Group with precipitation expressed in inches/year rather than millimeters/yr and the display altered to fit the EnviroAtlas national map HUC framework. One may click on individual HUCs to see estimated average precipitation within the HUC. The

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average annual precipitation map may be overlaid and compared with other EnviroAtlas maps depicting land cover and habitat, ecoregions, agriculture, or water supply and demand to reveal how precipitation levels relate to landscape character, ecosystems services, and productivity.

For example, one could relate this precipitation map to regional water supply by comparing it with EnviroAtlas maps depicting number of major dams and water supply from reservoirs in millions of gallons (summarized by 12-digit HUC). The user can increase the transparency of the overlying map to examine the base map beneath and add data for streams and water bodies (NHDPlus, found under the boundaries icon) to view the drainage network and the potential locations of dams and reservoirs.

How were these data created?

The annual precipitation values were estimated from maps produced by the PRISM Climate Group, Oregon State University. The original data was at the scale of 800 m grid cells, representing average precipitation from 1981–2010 in mm. PRISM calculates a separate climate-elevation regression for each pixel. The data was converted to inches of precipitation and then zonal statistics were estimated for a final value of average annual precipitation for each 12 digit HUC. For more information about the original dataset, please refer to the PRISM website. For more details on data creation, see the metadata**.**

What are the limitations of these data?

The PRISM model was developed to provide a statistical estimate of precipitation amounts even in remote or mountainous areas not covered by weather station data. It is based in part on an assumption of a linear relationship between precipitation and elevation. Grid cells are fairly coarse at 800 m (about ½ mile). For EnviroAtlas, data conversion from millimeters to inches, rounding of precipitation amounts, and compilation by HUC further altered the presentation of the original modeled data. As a result, precipitation estimates should not be expected to match observational data for specific locations.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. The HUC dataset may be downloaded at the NHDPlus website.

Where can I get more information?

A selection of resources related to the importance of average annual precipitation data is listed below. 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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Selected Publications

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2. Mauget, S.A. 2003. Multidecadal regime shifts in U.S. streamflow, precipitation, and temperature at the end of the twentieth century. *Journal of Climate* 16: 3905–3916.

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5. Spierre, S.M., and C. Wake. 2010. Trends in extreme precipitation events for the northeastern United States 1948–2007. Carbon Solutions New England, University of New Hampshire, Durham, New Hampshire. 17 p.

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