Climate Scenarios (1950–2099): Precipitation

This EnviroAtlas national map displays projected seasonal (fall, winter, spring, summer) and annual precipitation using four future greenhouse gas (GHG) concentration scenarios (see box) for the contiguous United States. Estimates of precipitation are in total inches.

Why is it important to forecast precipitation?

The potential impacts of climate change, and subsequent changing of the amount and timing of precipitation, can be found in virtually every aspect of daily life.[1] Changes in the amount of precipitation occurring in an area can cause increased cloudiness, extreme heat events, and more frequent climate extremes[2]. Other potential impacts include increased risk of drought and heat waves and an increased probability of intense precipitation events and flooding.[3]

To assess the risk of crossing identifiable thresholds in both physical alteration and impacts on biological and human systems, it is important to consider a range of possible changing precipitation regimes.[4] These scenarios describe possible trajectories of future precipitation and can be used to explore the implications in social, economic, political, and environmental fields.[5]

Exploring how the natural environment and human societies potentially will be impacted by changing precipitation, and how we can mitigate and adapt to such changes is important for both the US and the global population. Furthermore, understanding how shifting precipitation regimes will affect ecosystems can help ensure their continued protection and ability to provide services to society.

How can I use this information?

This series of maps can be used to help evaluate the potential risk of crossing identifiable thresholds in both physical change and impacts on biological and human systems. Understanding how precipitation may change in the future is a critical step toward identifying possible degradation and changes in trends in supply and demand of many ecosystem services. Identifying the potential threats of a changing climate and contributing factors may also help communities with developing climate adaption and resiliency strategies. Within EnviroAtlas, this map can be used in combination with many of the map layers. Examples include exploring future precipitation in connection with water use maps, species richness layers, and the many agricultural related maps such as crop yields (cotton, fruit, grain, and vegetables), and total hectares of crops.

Representation Concentration Pathways

The Intergovernmental Panel on Climate Change (IPCC) has periodically created climate change scenarios to explore future developments in the global environment with special reference to the production of GHGs and aerosol emissions. These scenarios can be used to make projections about future climate and to understand potential vulnerabilities to climate change. The Representation Concentration Pathways (RCP) used in this work were released in 2014.

The IPCC developed four greenhouse gas concentration scenarios for the RCP, allowing for climate variables such as temperature, precipitation, and potential evapotranspiration to be created for the U.S.

RCP 2.6 – This scenario is characterized as having very low greenhouse gas concentration levels. It is a “peak-and-decline” scenario and assumes that GHGs are reduced substantially over time. This is the most benign climate scenario of the four.

RCP 4.5 – This scenario assumes stabilization will occur shortly after 2100 and assumes less emissions than RCP 6.0, which is also a stabilization scenario.

RCP 6.0 – This is a stabilization scenario in which the increase in GHG emissions stabilizes shortly after 2100 through the application of a range of technologies and strategies for reducing GHG emissions.

RCP 8.5 – This scenario is characterized by increasing GHG emissions over time and factors in the highest GHG concentration levels of all the scenarios by 2100.

Historical climate – The ensemble average for each RCP model historical run were included. This data is provided for the years 1950-2005.

Climate change scenarios can be very complex. The IPCC provides more information about the climate modeling effort and RCP scenarios.

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These projections can also be used in conjunction with the maps and data that illustrate the number of crop types within 12-digit hydrologic units (HUCs). Together, these data can be used to evaluate and identify areas where crop failure is likely to increase both in the immediate (e.g. 2020) and the distant future (e.g. 2080) due to changing precipitation. Specifically, the summer precipitation layer could be used to identify areas that historically have been vulnerable to drought when growing crops.

Future precipitation may highlight where ecosystems that protect threatened and endangered species may experience strain from increased flooding or drought, requiring additional protection or restoration.

How were the data for this map created?

These maps were created using the NASA Earth Exchange Downscaled Climate Projections (NEX-DCP30). The NEX-DCP30 datasets provide monthly minimum and maximum temperature along with precipitation in a gridded format (approximately 800 m^2) for each of over 30 global circulation models. We provide NEX-DCP30 ensemble averages (the average of all available models) for each of the four RCP scenarios for each season (fall, winter, spring, and summer) and annually for the years 1950–2099.

What are the limitations of these data?

All national geospatial data within EnviroAtlas are estimates, particularly with regards to projecting climate metrics into the future. The metrics generated from combining these data sets are the best estimation of plausible futures based on the best available data.

We provide summarized metrics using the ensemble average to reduce the variation that each individual global circulation model contains. Therefore, providing the ensemble average allows for regional trends to be evaluated and analyzed. Furthermore, we suggest using changing climate metrics over time periods of decades, rather than using a single year of data in isolation. Doing so will provide more realistic trends and remove potential variability that could be an artifact from a single year.

How can I access these data?

EnviroAtlas data, including seasonal and annual climate projections, can be viewed in the interactive map, accessed through web services, or downloaded. The NEX-DCP30 data can be downloaded from the NASA Center for Climate Simulation.

Where can I get more information?

There are numerous resources on climate change and future climate scenarios; a small selection of these resources is below. EPA and NASA have additional resources on their respective websites. For information on how the data were created, see the metadata. For specific questions about the NEX-DCP30 data, please visit the NASA Earth Exchange website. For additional information about the RCP scenarios, please visit the Intergovernmental Panel on Climate Change (IPCC) website. Specific questions about this map should be directed to the EnviroAtlas Team.

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Selected Publications

1. U.S. Global Change Research Program. 2016. Our Changing Planet: A Report by the U.S. Global Change Research Program and the Subcommittee on Global Change Research for Fiscal Year 2015. Accessed December 2016.

2. Wilhite, D.A., M.V. Sivakumar, and R. Pulwarty. 2014. Managing drought risk in a changing climate: The role of national drought policy. *Weather and Climate Extremes* 3: 4–13.

3. Intergovernmental Panel on Climate Change. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II, and III to the Fourth Assessment Report, Pachauri, R.K., and A. Reisinger (Eds.), IPCC, Geneva, Switzerland.

4. Intergovernmental Panel on Climate Change. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report, Stocker, T.F. et al. (Eds.), Cambridge University Press, Cambridge, U.K.

5. Thrasher, B., J. Xiong, W. Wang, A. Michaelis, and R. Nemani. 2013. Downscaled climate projections suitable for resource management. *EOS* 94(37): 321–323.