EnviroAtlas

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Fact Sheet

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Climate Scenarios (1976–2099): Precipitation

These EnviroAtlas maps show projected changes in total precipitation for each season (fall, winter, spring, summer) and annual period following four Shared Socioeconomic Pathways (SSPs, see inset at right) for states and territories outside of the contiguous U.S. (OCONUS): Alaska, Hawaii, Puerto Rico, U.S. Virgin Islands, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. Changes in precipitation are displayed both in inches and as fractions.

Why is it important to explore precipitation projections?

Rainfall is projected to change (increase or decrease, depending on the region), leading to increased risk of drought and heat waves, increased probability of intense precipitation events and flooding, and widespread changes to snowfall patterns.[1] To assess the risks of crossing identifiable thresholds in impacts on both physical processes and biological and human systems, it is important to broadly consider plausible changes to precipitation regimes.[2] It is important to understand how the natural environment and human societies could be impacted by changing precipitation to adapt to such changes. Understanding how shifting precipitation regimes will affect ecosystems can help ensure their continued protection and ability to provide services to society.[3]

How can I use this information?

This series of maps can help quantify the potential risks of exceeding identifiable thresholds in both physical change and impacts on biological and human systems. The maps can also assist with developing adaptation and resilience measures in the OCONUS territories. Understanding how precipitation may change in the future is a critical step in identifying possible degradation and changes in trends in supply and demand of ecosystem services. Identifying the potential threats from a changing climate and contributing factors may also help communities develop adaptation and resilience strategies. Projected changes in precipitation show where ecosystems that protect threatened and endangered species may experience strain from increased flooding or drought, requiring additional protection or restoration. These projections can also be used with additional datasets in EnviroAtlas. Future precipitation scenarios may be overlaid, if available, with layers such as Dasymetric Population and

Shared Socioeconomic Pathways

The Intergovernmental Panel on Climate Change (IPCC) develops climate change scenarios to explore the future global environment. These scenarios were a pillar for a major international climate modeling study, called the sixth phase of the Coupled Model Intercomparison Project (CMIP6.).[4] The IPCC and CMIP6 are recognized as the authoritative foundations for exploring global climate change.

CMIP6 scenarios are called Shared Socioeconomic Pathways (SSPs), with names coded to reflect global trends in human activities and changes in radiative forcing that result from changes in atmospheric greenhouse gases (GHGs) and aerosol concentrations. In the SSP labels (like SSP1-2.6), the first number refers to a defined socioeconomic pathway (reflecting trends in population, policy, and economic growth), and the second refers to an increase in radiative forcing ($W\ m^{-2}$) relative to preindustrial conditions. For reference, in comparison to the *preindustrial* (1850–1900) *average* (PIA), the 2023 observed global mean near-surface temperature increased by 2.61±0.22°F (1.45±0.12°C).[5]

There are four primary "Tier 1" SSPs.

SSP1-2.6: SSP1 ("Sustainability") assumes widespread global climate change mitigation policies, clean energy technologies, and natural environment conservancy. This scenario assumes very low GHG concentration levels and reflects the international climate policy goal of limiting global warming below 3.6°F (2.0°C) at 2100 compared to PIA.

SSP2-4.5: SSP2 ("Middle of the Road") assumes moderate global climate mitigation and adaptation and a slow progress in climate protection measures. This scenario is a medium GHG concentrations pathway. Global temperatures increase by 4.9±1.3°F (2.7±0.7°C) at 2100 compared to PIA.

SSP3-7.0: SSP3 ("Regional Rivalry") assumes high challenges to mitigation and adaptation. Here, nationalism drives policy, and regional and local take precedence over global issues. Global temperatures increase by 6.5±1.6°F (3.6±0.9°C) at 2100 compared to PIA.

SSP5-8.5: SSP5 ("Fossil-fueled Development") reflects high challenges to mitigation and low challenges to adaptation. It is characterized by steadily increasing GHG concentrations. It represents the upper boundary of the range of scenarios. Global temperatures increase by 7.9±2.2°F (4.4±1.2°C) at 2100 compared to PIA.

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Residential Density or with Percent Forest and Woody Wetlands in Stream Buffers to help identify areas to prioritize for conservation, adaptation, and resilience activities to prepare communities for changing precipitation patterns.

How were the data for these maps created?

These maps were created using bias-corrected data from NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP-CMIP6),[6] which is the first downscaled dataset to include localized projections for the United States and all of its territorial lands. The NEX-GDDP-CMIP6 precipitation datasets (0.25° × 0.25°) were obtained in a gridded format for each of the 35 members of the CMIP6 global climate model ensemble. NEX-GDDP-CMIP6 data are shown in EnviroAtlas as projected changes between periods reflecting recent history (1976–2005), near-term future (2025–2054), mid-century (2045–2074), and end-of-century (2070–2099). Each value is the ensemble median, and the ensemble minima and maxima provide ranges for each HUC12 and SSPs for each season (fall, winter, spring, and summer) and annual period. Due to low historical precipitation values, the data for Alaska is not available in fraction units.

What are the limitations of these data?

All national geospatial data within EnviroAtlas are estimates, particularly with regard to projecting climate variables into the future. The aggregated datasets reflect plausible future trajectories based on the state of the science. Even though this dataset is the first known downscaled dataset available throughout the OCONUS locations, it originates from one modeling source based on a specific methodology[7]. Datasets for these regions from other comparable data sources may show different ranges of variability. EnviroAtlas provides the ensemble median, maximum, and minimum to illustrate variability and allow regional trends to be evaluated and analyzed. Furthermore, climate change metrics were computed using 30-year periods to remove artifacts from single-year events. Due to the lack of validation data over oceans, NEX-GDDP-CMIP6 values over smaller island areas may have lower confidence.[6,7]

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-GDDP-CMIP6 data can be acquired from the NASA Center for Climate Simulation.

Where can I get more information?

Additional information on climate change can be found at the EPA website. For information on how the data were created, see the metadata. For specific questions about the NEX-GDDP-CMIP6 data, please see the NASA Center for Climate Simulation technical note.[7] For additional information about the Shared Socioeconomic Pathways scenarios, please visit the IPCC website. Specific questions about these maps should be directed to the EnviroAtlas Team.

Acknowledgments

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Selected Publications

1. U.S. Global Change Research Program. 2023. Fifth National Climate Assessment. Accessed April 2025.
2. Stocker, T.F. et al., eds. 2018. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K., and New York, NY. 1585 pp.
3. Lee, H., and J. Romero, eds. 2023. Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland, 184 pp.
4. Lee, J.-Y., et al. 2021. Future global climate: Scenario-based projections and near-term information. Pages 553–672 *in* Masson-Delmotte, V., et al. (eds.), Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, U.K., and New York, NY.
5. World Meteorological Organization (WMO). 2024. State of the Global Climate 2023. World Meteorological Organization, Geneva, Switzerland, 53 pp.
6. Thrasher, B., et al. 2022.NASA Global Daily Downscaled Projections, CMIP6. *Scientific Data* 9**:** 262.
7. Thrasher, B., et al. 2012. Technical Note: Bias correcting climate model simulated daily temperature extremes with quantile mapping. *Hydrology and Earth System Sciences* 16:3309–3314.