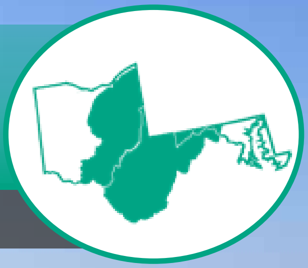
Central Appalachians

Ecosystem Vulnerability Assessment and Synthesis



SUMMARY AND HIGHLIGHTS

The Central Appalachians region covers 29 million acres from the shores of Lake Erie to the peaks of the Allegheny Mountains. This region contains a mosaic of high-elevation boreal forests, upland forests and woodlands, riparian, and floodplain forests that are an essential part of the landscape.

Ecosystems will increasingly be affected by a changing climate. Understanding these potential impacts is an important first step to sustaining healthy forests in the face of changing conditions.

As part of the Central Appalachians Climate Change Response Framework project, more than 40 scientists and forest managers collaborated to assess the vulnerability of forest ecosystems in this region to the likely range of projected climate change. Learn more about other project activities at: **www.forestadaptation.org/central-Appalachians.**

The climate has changed

Although the annual average temperature in the Central Appalachians has remained generally the same between 1901 and 2011, minimum temperatures have increased by 1.1 °F. By season, minimum temperatures have warmed the most during summer and fall. Both minimum and maximum temperatures increased in April and November, the two fastest warming months.

Minimum temperatures increased by 1.6 °F in summer and 1.4 °F in fall. Maximum temperatures increased by 3.2 °F in April and 1.8 °F in November.

Across the region, precipitation has increased in the fall by an average of 2.3 inches (8 percent) and has decreased in the winter by an average of 1 inch Extreme rain events of 3 inches or greater have become more frequent, while light rain events have decreased.

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Downscaled climate models can help us understand how climate may respond to future changes in greenhouse gas emissions. In this assessment, we report climate projections for two climate models (GFDL and PCM) under two contrasting greenhouse gas emissions scenarios (A1FI:high and B1:low) over the next century compared to the average over the last 30 years of the 20th century.

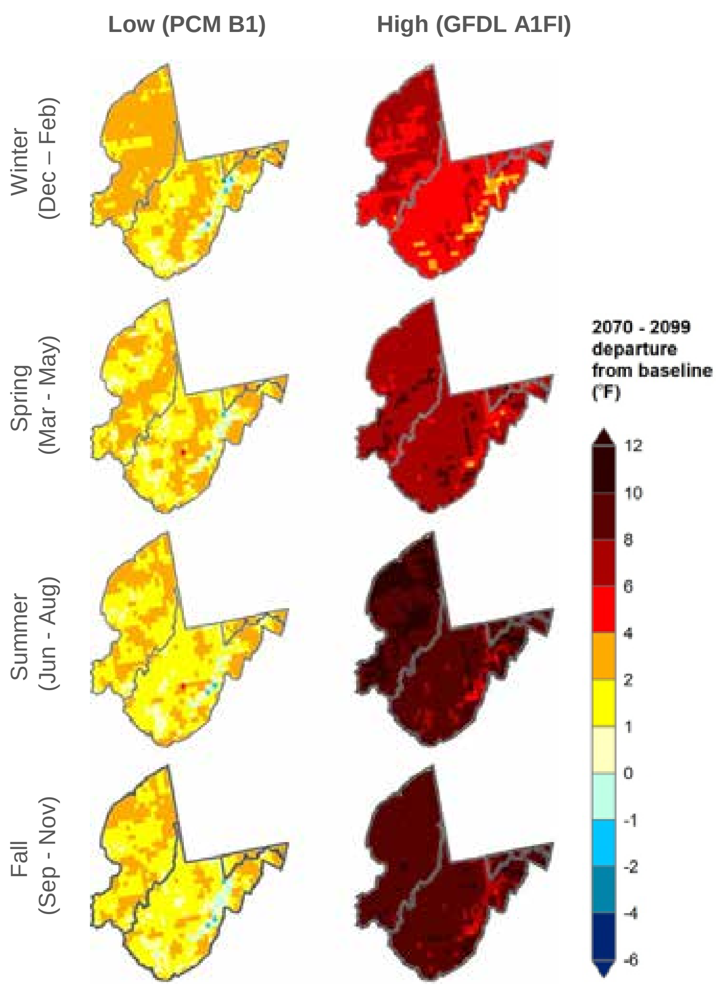
Temperatures will increase

All climate models project that average temperatures will increase in the Central Appalachians. For the low climate scenario, the projected change ranges from 1 to 4 °F, (see maps below). For the high climate scenario, projected increases range from 4 to 12 °F.

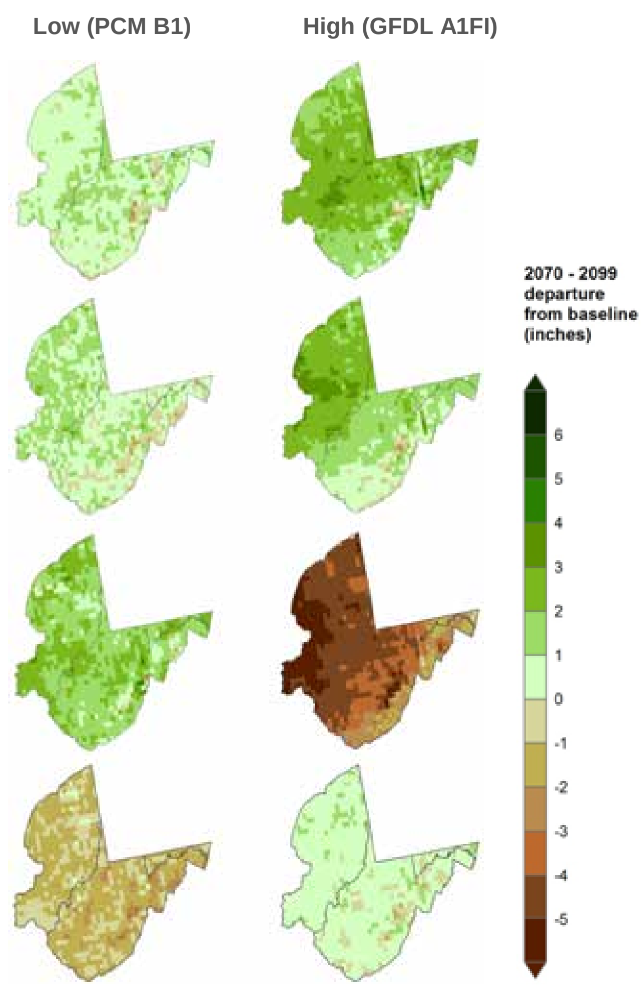
Precipitation will change

The two climate scenarios describe a wide range of possible future changes in precipitation. Both models agree that precipitation is projected to increase in winter and spring, more so under the high climate scenario. Models disagree about the timing of possible seasonal decreases in either summer or fall, depending on scenario. There may be greater moisture stress later in the growing season, especially as increasing temperatures lead to increased water loss from evaporation and transpiration. Evidence also suggests rain may occur during heavier rain events interspersed among relatively drier periods.

CHANGE IN MEAN TEMPERATURE



CHANGE IN PRECIPITATION



These maps describe a range of projected changes. *Projected difference in mean daily temperature and total seasonal precipitation at the end of the century (2070 through 2099) compared to 1971 through 2000 for two climate model-emissions scenario combinations.*

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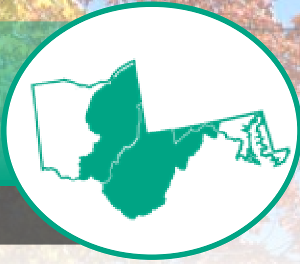

Forests will experience both direct and indirect impacts from a changing climate

Two climate models, three forest impact models, hundreds of scientific papers, and professional expertise were combined to assess the effects of climate change on regional forest ecosystems. Based on this information, there is a large amount of evidence to suggest that the following impacts will occur in the Central Appalachians region.

Soil moisture patterns will change, with drier soil conditions in summer and fall.

Due to potential decreases in summer and fall precipitation and increases in winter and spring precipitation, it is likely that soil moisture regimes will also shift. Longer growing seasons and warmer temperatures may also result in greater evapotranspiration and lower soil water availability later in the growing season.

Fire risks will increase.

National and global studies agree that wildfire risk will increase across the region, especially in drier areas. Fire is expected to accelerate changes in forest composition, promoting changes in species faster than temperature or moisture availability.

Early growth and advance regeneration will be vulnerable to changes in moisture.

Predicted changes in temperature, precipitation, growing season onset, and soil moisture may alter the duration or quality of germination conditions. After establishment, saplings may still be more sensitive than mature trees to disturbances such as drought, heat stress, frost, fire, and flooding.

Download the full assessment
www.nrs.fs.fed.us/pubs/47885

Download a copy of this summary and more:
www.forestadaptation.org/CentralAppalachians

Suitability for southern species will increase.

Forest impact models project increases in suitable habitat and volume for many species with ranges largely south of the region, including shortleaf pine, post oak, and blackjack oak. Habitat suitability may increase for species currently planted in the region, such as loblolly pine. Most species are not expected to migrate fast enough to keep up with shifting habitat. Development, fragmentation, and other physical barriers to seed dispersal may further slow natural migration of trees.

Suitability for northern species will decline.

Forest impact models project decreases in habitat suitability for northern species such as eastern hemlock, and red spruce, which are currently limited to specific landscape positions where conditions are cool and moist. These microhabitats may provide some refugia for these species, but their presence on the landscape may become rare. Populations of sugar maple and other northern species maybe able to persist in southern refugia if new competitors from the south are unable to colonize.

Invasive plants, pests, and pathogens will increase or become more damaging.

A warming climate has allowed some invasive plant species, insect pests, and pathogens to survive further north. Threats such as the southern pine beetle, oak decline, and invasive plants such as kudzu, bush honeysuckles, and cogongrass may increase in the future.

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Vulnerability of Forest Communities

Climate change will not affect all forest species, communities, and parts of the landscape in the same way. A panel of experts from a wide range of organizations worked together to assess the vulnerability of forest ecosystems to climate change.

Vulnerability is the susceptibility of a system to the adverse effects of climate change. It is a function of potential climate change impacts and the adaptive capacity of the system. A system is vulnerable if it is at risk of a fundamental change in identity, or if the system is anticipated to suffer substantial declines in health or productivity.

Of nine forest ecosystems assessed, the spruce/fir and Appalachian (hemlock)/northern hardwood forests were considered highly vulnerable due to negative impacts on dominant species and a limited capacity to adapt to disturbances such as drought and defoliation. Dry oak and oak/pine forests were considered less vulnerable because they have more drought and heat-adapted species and are better able to withstand large-scale disturbances. Riparian forests are also vulnerable to potential shifts in flood dynamics.

These determinations of vulnerability are general across the region, and will be influenced by local conditions, forest management, and land use. The high diversity in landforms, microclimates, hydrology, and species assemblages across the region greatly complicates assessment of vulnerability. It is essential to consider local characteristics when interpreting vulnerabilities at local scales. The assessment does not consider adaptive management actions, changes in land use, or other social or economic factors that could affect forest health or productivity.

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What can managers do?

Confronting the challenge of climate change presents opportunities for land managers to plan ahead, foster resilient landscapes, and ensure that the benefits that forests provide are sustained into the future.

Forest managers will naturally have different goals and objectives, and different opportunities and challenges for how they might respond to climate-related risk. Managers can use scientific information from the assessment in combination with site-specific knowledge to determine which places may be most vulnerable.

Resources are available to help natural resource managers and planners to incorporate climate change considerations into forest management. A set of Forest Adaptation Resources is available at www.forestadaptation.org.

More information

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The Climate Change Response Framework is a core forest adaptation effort of the USDA Midwest and Northeast Climate Hubs.

Citation

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