COMMUNITY CLIMATE
COLLABORATIVE

LOCAL EFFECTS OF CLIMATE CHANGE

Charlottesville, VA | June 2020

The effects of climate change have both a global and local impact. This report explains how local biodiversity, public health and safety, agricultural production, and energy bills have already been impacted by climate change with considerations for how these effects may continue to impact the City of Charlottesville and Albemarle County in the future.

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Climate change will directly impact the City of Charlottesville and Albemarle County. Local temperatures and precipitation have already increased over time due to global warming and will continue to intensify in the coming years.[1] Under business-as-usual human activity, the top climate hazards [2] predicted to affect the Charlottesville Area are projected to be extreme precipitation, drought, warming, heatwaves, and storms (Figure 1).[3] These hazards will impact not just biodiversity, but also public health, safety, agricultural production, and energy bills. Charlottesville Area residents should be aware of the effects of climate change and how their daily life will be impacted.

HEALTH AND SAFETY

Extreme Precipitation

Precipitation is projected to increase over time and remain the top climate hazard for Charlottesville by 2050.[4] Rising temperatures will cause rainfall to be less frequent yet more extreme when it does occur.[5] From the 1890s to 2010s, the average number of days with extreme rainfall [6] per year has increased 78%.[7] Between 1995 and 2015, Albemarle County and Charlottesville collectively experienced 98 floods, resulting in 1 death and nearly $1.15 million in asset losses.[8] Already, increased precipitation and flooding have affected Albemarle County (Figure 1) [9].

Figure 1. Flooding at Swift Run Bridge, Albemarle County in 2017

> Minor flooding may lead to school and road closures, whereas heavy downpours create safety hazards, as floods can cause power outages, damage infrastructure, and, in the most dangerous scenarios, even be lethal.[10]

Flooded buildings can develop mold, diminishing indoor air quality, which could lead to respiratory tract irritation and infections, including pneumonia for those living in damp conditions.[11] Halted economic activity due to damaged assets or infrastructure could impose further costs.[12]

Extreme Heat

Under a high-emissions scenario, the average daily maximum temperature in Charlottesville is predicted to increase from approximately 70˚F to 78˚F in the next 80 years.[13]

While the average temperature may climb relatively slowly, it represents a dramatic spike in the number of days per year with extreme heat.[14] The number of days per year with a heat index above 105 ˚F has historically been isolated to a single day in Charlottesville; this number could potentially jump to 20 by midcentury and 47 by late century (Figure 2).[15]

Rising temperatures due to human-led climate change will have serious health impacts, increasing the risk of heat exhaustion, stroke, and even heat-related fatalities. Extreme heat will be most dangerous for people aged 65 and older, children below 5 years old, and those below the poverty line.[16] Additionally, stagnant air during periods of elevated heat may promote the buildup of dangerously high levels of air pollutants and ground-level ozone.[17]

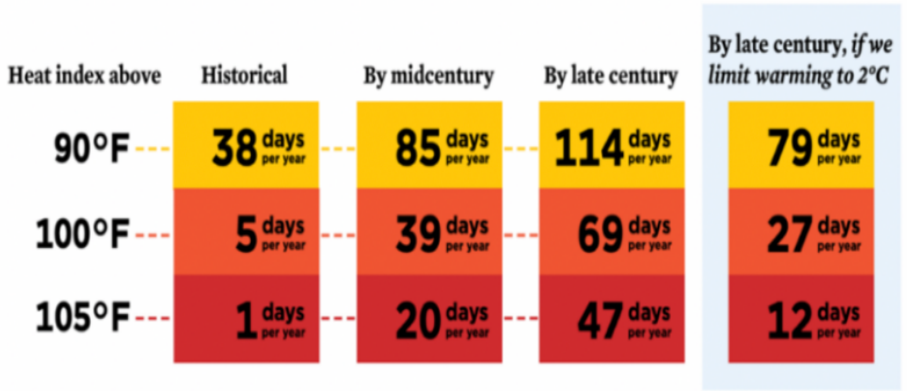

Figure 2. Predicted Annual Days of Extreme Heat Per Year in Virginia's 5th District.

Insects and Ticks

With warming temperatures, disease-carrying insects and ticks emerge earlier and live longer, increasing the risk of contracting vector-borne diseases such as Lyme disease.[18] Similarly, hotter and more humid summers have lengthened the mosquito season. Between 1989 and 2006 alone, Charlottesville's mosquito season has grown from 96 to 114 days, a 19% increase in 17 years.

> A longer mosquito season increases the risk of mosquito-borne infections like Zika virus, West Nile Virus, dengue, and malaria, potentially leading to many adverse or even fatal health effects.[19]

BIODIVERSITY

Currently, approximately 61% of Virginia is covered by forests, which serve as habitats for hundreds of wildlife species. Changing climatic conditions will likely impact the diversity of trees on the Commonwealth's landscape. For instance, is anticipated that red spruce trees could become extinct in Virginia within the coming decades as its climate will become unsuitable for the species. [20]

Changing forest composition could have significant secondary impacts, affecting wildfire frequency, water quality, invasive species spread, and botanical disease.[21] Particularly, acorn production could be reduced, diminishing food availability for birds and small mammals, forcing such animals to increasingly forage in town and cities. [22] [23]

AGRICULTURE

Agriculture in Virginia provides over 334,000 jobs with, with Albemarle being the state's second producer of fruits, tree nuts, and berries. [24] [25]

Higher temperatures would also decrease livestock productivity due to heat stress on animal metabolism.[26] With one apple requiring nearly 30 gallons of water to be produced and meat livestock making up 39% of the state's top agricultural commodities sales, climate change is sure to ripple throughout the Virginia and Albemarle economies.[27]

Rising temperatures would also affect our region's aquaculture economy, as they promote the growth of oxygen-depleting algal blooms and drive out aquatic species requiring cooler habitats.[28]

ENERGY BILLS

Due to global warming, the number of Cooling Degree Days (CDD) is projected to increase, leading to more frequent air conditioning use to combat warmer outside temperatures. [29] [30] The number of CDD in Charlottesville will likely increase by 90% by 2050 and 119% by 2100. The higher demand for cooling during peak demand hours will increase the strain on the energy grid and, consequently, the likelihood of blackouts.[31] [32]

C3's team was able to estimate the increase in local electricity bills due to climate change.[33]

> In the Charlottesville Area, electricity bills are expected to increase by 67% by 2050 and 89% by 2100. Assuming a residential bill of $1,644/year, this would represent a surge of $1,100 to $1,460 on a household's annual bill cost. [34] [35]

CONCLUSION

As local temperatures increase and precipitation intensifies, the negative effects of climate change will directly affect our public health, leisure opportunities, natural landscape, and economic security with disproportionate effects to the most vulnerable households. The right time to act to mitigate climate change is long past. By taking immediate, ambitious climate action to reduce greenhouse gas emissions and preserve natural resources, we can still minimize the worst impacts of global warming. Take the next step forward. Contact us at info@theclimatecollaborative.org to learn more about how we can work together to tackle this climate crisis.

1 Irfan, U., Barclay, E. & Sukumar, K., 2019. Weather 2050. [Online]
Available at: https://www.vox.com/a/weather-climate-change-us-cities-global-warming

2 A climate hazard is defined as a physical process or event risking to or currently posing harm to human health, livelihoods, or natural resources.

3 Climate Central, 2019. Top Climate Hazards in 2050. [Online]
Available at: https://wxshift.com/news/graphics/top-climate-hazards-in-2050

4 Climate Central, 2019, op. cit.

5 National Oceanic and Atmospheric Association, n.d. U.S. Climate Resilience Toolkit. [Online]
Available at:
https://noaa.maps.arcgis.com/apps/MapJournal/index.html?appid=92260a6bcf154d72bab62e50231e64c8&section=6%5C. [Accessed January 2020].

6 For the purposes of this report, extreme rainfall is defined as daily precipitation greater than 3 inches.

7 National Oceanic and Atmospheric Association, n.d, op. cit.

8 Thomas Jefferson Planning District Commission, n.d. Regional Natural Hazard Mitigation Plan 2018. [Online]
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[Accessed January 2020].

9 Albemarle County Police Department, 2017. Traffic Alert: Swift Run Bridge is Under Water. [Online]
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10 Howard, J., 2019. Flood Safety Tips and Preparation. [Online]
Available at: https://www.nationalgeographic.com/environment/natural-disasters/flood-safety-tips/

11 Centers for Disease Control and Prevention, n.d. Climate Change Increases the Number and Geographic Range of Disease-Carrying Insects and Ticks, s.l.: Centers for Disease Control and Prevention.

12 Allaire, M., 2018. Socio-economic impacts of flooding: A review of the empirical literature. Water Security, pp. 18-26. Center for Disease Control and Prevention, n.d. Extreme Rainfall and Drought. [Online] Available at:
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[Accessed January 2020].

13 National Oceanic and Atmospheric Association, n.d, op. cit.

14 For the purposes of this report, extreme heat is defined as a daily heat index of 90 °F or higher.

15 Union of Concerned Scientists, 2019. Extreme Heat in Virginia's 5th District, s.l.: Union of Concerned Scientists.
16 (Union of Concerned Scientists, 2019,, op. cit.)

17 United States Department of Agriculture, 2015. Forests of Virginia. [Online]
Available at: https://www.srs.fs.usda.gov/pubs/ru/ru_srs129.pdf
[Accessed January 2020].

18 Centers for Disease Control and Prevention, 2019. Lyme Disease Maps: Most Recent Year. [Online]
Available at: https://www.cdc.gov/lyme/datasurveillance/maps-recent.html

19 Climate Central, 2016. More Mosquito Days Increasing Zika Risk in U.S.. [Online]
Available at: https://www.climatecentral.org/news/more-mosquito-days-increasing-zika-risk-in-us-20553

20 Kane, A., Burkett, C., Klopfer, S. & Sewall, J., 2013. Virginia's Climate Modeling and Species Vulnerability Assessment: How Climate Data Can Inform Management and Conservation, Reston, Virginia: National Wildlife Federation. National Oceanic and Atmospheric Associaiton, n.d. U.S. Climate Resilience Toolkit. [Online] Available at:
https://noaa.maps.arcgis.com/apps/MapJournal/index.html?appid=92260a6bcf154d72bab62e50231e64c8&section=6%5C[Accessed January 2020].

21 Kane, Burkett, Klopfer, & Sweall, 2013,, op. cit.

22 Kane, Burkett, Klopfer, & Sweall, 2013, op. cit.

23 Staudt, A., Shott, C., Inkley, D. & Ricker, I., 2013. Wildlife in a Warming World: Confronting the Climate Crisis, s.l.: National Wildlife Federation.

24 Virginia Department of Agriculture and Consumer Services, 2017. VIRGINIA'S TOP 20 FARM COMMODITIES. [Online] Available at: https://www.vdacs.virginia.gov/agriculture-top20.shtml

25 United States Department of Agriculture, 2017. Census of Agriculture. [Online]
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27 United States Department of Agriculture, 2017, op. cit.

28 Climate Central, 2018. Rising Tides: How Near-Daily Flooding of America's Shorelines Could Become the Norm. [Online] Available at: https://www.climatecentral.org/news/rising-tides-near-daily-flooding-americas-shorelines-21935

29 Cooling Degree Days measure the demand to cool a building, based on days when the outside temperature is above the typical thermostat setpoint (65 °F).

30 Habitat Seven, n.d. Cooling Degree Days. [Online] Available at:
https://noaa.maps.arcgis.com/apps/MapJournal/index.html?appid=92260a6bcf154d72bab62e50231e64c8&section=6

31 Climate Central, 2019, op. cit.

32 In addition to it, studies have shown that air conditioning (A/C) systems are designed to accommodate up to a 20°F difference between the outside and inside temperature. Hence, during extremely hot days it will be nearly impossible to reach a comfortable temperature inside without the A/C working overtime and causing problems such as excess humidity.
33 Based on published estimations of the linear regression coefficient and the elasticity coefficient between the dollar value of electricity bills and changes in the annual number of Cooling Degree Days.

34 Based on Virginia's average residential bill cost for 2018.
35 Energy Information Agency (EIA), 2019. State Electricity Profiles (Virginia). [Online]
Available at: https://www.eia.gov/electricity/state/virginia/
[Accessed 29 January 2020].