

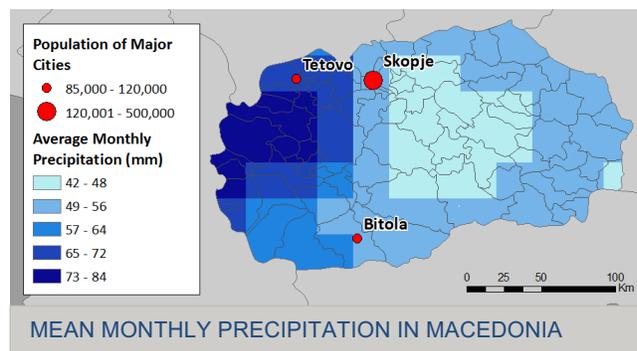


# CLIMATE RISK PROFILE NORTH MACEDONIA

## COUNTRY OVERVIEW

A small, landlocked country on the Balkan Peninsula, North Macedonia features a diverse topography with eight distinct biomes. Spanning 25,713 square kilometers (km<sup>2</sup>), North Macedonia contains tall mountains and deep valleys that form four major river basins (Vardar, Strumica, Crn Drim, and Juzna Morava) and feed three large natural lakes located in the south of the country.

Mountainous and hilly terrain covers 79 percent of the land area, while plains cover 19 percent. According to the most recent census conducted (in 2002), the population of 2.1 million is fairly evenly distributed with 57 percent living in urban areas. North Macedonia lags behind many transitional countries in education performance and inclusion of people with disabilities in mainstream education. Additionally, educational instruction has historically been separated along ethnic lines (e.g., primary school through universities with instruction delivered in North Macedonian or Albanian). Agriculture is responsible for 10 percent of the Republic's gross domestic product (GDP), employs 17 percent of the workforce, and utilizes almost 50 percent of the land for cropland and pastures. North Macedonia is characterized by a variable climate, which, combined with rising temperatures and more extreme weather events, such as floods and drought, due to climate change, put the country's agriculture sector at risk. Forests cover about 40 percent of the country's land, and higher temperatures combined with drought increase the risk of wild fires. With a relatively open economy, reliance on foreign trade is high and, except during the global economic crisis, economic growth has remained stable since the country gained independence in 1991. However, unemployment has remained high and currently sits at 22.4 percent (21.8 for women and 22.7 for men, with the 15-24 age group slightly above 45 percent). Services and industry account for the remaining 90 percent of GDP, comprising 30 and 60 percent, respectively, of a total 2017 GDP of \$11 billion. Notable industries include food and beverage products, electricity, gas, steam, and air conditioning supply, and textiles manufacturing. Road systems and infrastructure are well developed, though transportation energy use per capita is lower than most other European countries. While traditionally not



### CLIMATE PROJECTIONS



1.0– 3.3° C increase in temperatures by 2050



5% decrease in average annual precipitation by 2050, with a 17% decrease in summer patterns



Increased frequency and severity of drought

### KEY CLIMATE IMPACTS



**Agriculture**  
Reduced crop yields  
Damage to crops and livestock  
Soil erosion



**Water Resources**  
Reduced water availability  
Reduced water quality  
Greater flood risk



**Energy**  
Damage to energy infrastructure  
Loss of hydropower generation



**Ecosystems**  
Loss of biodiversity  
Forest degradation  
Reduced forest productivity

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competitive in the tourism industry, North Macedonia has been prioritizing growth in this sector since 2009. (7,8,11,13,16,17)

## CLIMATE SUMMARY

North Macedonia has a diverse climate, with eight distinct climate zones: sub-Mediterranean, moderate continental sub-Mediterranean, warm continental, cold continental, sub-forest continental mountainous, forest continental mountainous, sub-alpine mountainous, and alpine mountainous. Notable ecosystems include: temperate forests, grasslands, and wetlands. The average annual temperatures range from 10.1°C to 14.3°C with significant variation between regions and throughout the year; in January, the monthly average dips below zero, to -0.9°C, while in July and August the monthly average reaches 20.3°C. Driven by differences in elevation, two basic rainfall regimes exist in North Macedonia, the Mediterranean and continental. Regions in the Mediterranean regime experience high levels of rainfall in October through December, while regions in the continental regime see most of their rainfall in the months of May and June. Annual precipitation totals about 1,000 mm in the wettest areas and 400 mm in the driest. The mountain ranges in the west have the largest amount of precipitation, with the summit of Baba Mountain receiving around 1,000 mm annually. Regions in central and southern areas of the country are the driest, with less than 400 mm of annual precipitation. (2,7,9,13,18)

### HISTORICAL CLIMATE

Climate trends include:

- Increase in average annual temperatures of 0.2 to 0.5°C between 1981 and 2010. Increases have been higher in summer months.
- Across Europe, the increase in frequency of hot days has almost tripled and summer heat wave length has doubled since 1880. The number of warm days has increased between 4-10 days per decade between 1961 and 2012.
- Seasonal and regional variability in precipitation is high, but records indicate a general trend of decreasing average annual precipitation. (3,9)

### FUTURE CLIMATE

Climate projections include<sup>1</sup>:

- Increase in annual average temperature of 1.0 – 3.3°C by 2050. Increases are expected to be higher in summer months.
- An increase in number of hot days, hot nights, and heat waves.
- Projected 5% decrease in annual average precipitation by 2050, with 17% decrease expected in summer.
- Likely increase in precipitation variability.
- Likely increase in frequency and intensity of droughts, with the probability of projected change in annual severe drought likelihood increasing by between 0.23 and 0.37 by 2060.
- A 2°C increase in temperature puts 6 of the 7 ski resorts in North Macedonia at medium to high risk of no longer being snow secure in the future. (1,8,16)

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<sup>1</sup> Relative to the period 1961-1990.

## SECTOR IMPACTS AND VULNERABILITIES

### AGRICULTURE

North Macedonia's agriculture sector makes up a relatively small portion of GDP (10%) and employs 17% of the workforce. However, with a high unemployment rate, agricultural activities are of critical importance to the wellbeing of around half the population. There are approximately 193,000 family farms, a high figure for a country with a population of 2.1 million. Though the country is well-suited to grow a wide variety of products, including most continental and Mediterranean crops, the agriculture sector and related rural economic activities are particularly vulnerable to changes in climate. During an average year, evapotranspiration is higher than rainfall, and prolonged heat waves and dry periods in 2008 and 2012 led to significant production losses. With less than 10% of agricultural land irrigated, this trend can be expected to continue as climate change causes temperatures to rise and continues to drive more frequent and intense heat waves and drought. Increased temperatures also have the potential to negatively impact crop growth cycles by reducing the amount of time available to develop the harvestable portions of plants in the proper temperature range. Crop modeling in the Southeast region of the country predicts a dramatic shift in growing season for wheat and maize, with 21 and 56 percent decreases in yield, respectively, by the year 2025, which could cause reduced human and livestock nutrition. However, some studies indicate that increased temperatures could lead to increased yields in some areas of the country, assuming sufficient water is available. These benefits are likely to be offset due to the lack of irrigation in many areas, and the lack of adaptive capacity country wide. This may be particularly true in rural areas, where the rural poor will be most impacted by climate change due to their reliance on agriculture combined with their lack of adaptive capacity. Increased temperatures may also increase exposure to crop and livestock pests and diseases. The country also suffers from severe erosion, with approximately 44% of the country impacted by erosion. This is mostly due to poor land management, but climate change, particularly potential increases in extreme weather events could lead to increased risk of erosion. (2,7,9,14,15,17).

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Increased evapotranspiration	Reduced water availability for agriculture
Increased drought frequency and duration	Flood related crop and soil damage
More frequent and severe floods	Difficulty maintaining sanitation systems and practices
Increased temperatures	Increased adverse health effects
	Decreased snowpack, and earlier runoff

### WATER RESOURCES

Water resources in North Macedonia are spatially diverse, with the quantity depending on precipitation and snowmelt. Increase temperature will change snowpack and snowmelt patterns, likely leading to overall less snowpack, especially at lower elevations, and early runoff. North Macedonia's ski resorts are also at risk, as most of them are located between 1,200 – 1,600 m, an altitude that will likely see more rain and less snow with increased temperatures. Freshwater springs are primarily used for micro-scale water supply due to low yield, though in some cases yield is large enough to be captured for supply for small cities and villages. Water resources are extremely sensitive to the effects of climate change, both in terms of quantity, quality, and timing with total average precipitation expected to decrease in the country. Rural areas often don't have access to fresh water, which could be exacerbated by climate change. The adverse effects will be particularly acute in agricultural areas where water is not available for irrigation, likely resulting in decreased yields. By 2050

Climate Stressors and Climate Risks AGRICULTURE	
Stressors	Risks
Increased temperatures	Reduced crop yields
Increased drought frequency and duration	Crop failures
Increased heat wave frequency and intensity	Decreased nutritional health
Increased erosion risk	Soil erosion and soil fertility loss

water demand related to irrigation of crops during the summer months is expected to increase by as much as 50 percent, while overall water availability is expected to decrease by 30 to 40 percent over the same time horizon. This will even affect areas in the western part of the country that are relatively rich in water resources. Climate change also has the potential to increase the frequency and severity of flooding events. This is particularly problematic during spring months, as it can prevent the planting of summer crops, and during late summer when it can prevent timely harvesting or cause water-logging of roots. Erosion is also a major concern in the country, as it can decrease both soil and water quality. Primarily due to poor land management, but combined with steep slopes and unfavorable soil properties, 44 percent of the country is at severe risk for erosion. Poor farming practices in areas prone to erosion can lead to pollution of waterways and damage to reservoirs and other irrigation and drainage infrastructure. In addition to environmental risks, lack of water availability could negatively affect human health. (2,7,9,14,17)

## ENERGY

North Macedonia's electricity is predominantly generated by fossil fuel (predominantly lignite coal) and hydroelectric plants, which account for 64 percent and 33 percent of generation capacity, respectively. The remaining 3 percent comes from renewable sources and 100 percent of the population has access to electricity. Importantly, given North Macedonia's historical reliance on coal, the country has committed to reduce CO<sub>2</sub> emission from fossil fuels by 30 percent compared to business as usual scenarios; this will also help address the extremely high rates of particulate pollution in parts of the country, particularly Skopje which may have the worst air pollution in Europe. A substantial investment has been made in hydropower in recent years, and this trend is planned to continue as electricity demand grows and older fossil fuel plants reach the end of their lifespan. However, hydropower plants are vulnerable to the expected countrywide reduction in precipitation as well as from increased landslide risk and higher erosion rates. Alongside hydropower, North Macedonia is also increasing investment in natural gas. By 2050 natural gas, which accounted for 2% of energy in 2012, is expected to account for 20% of the country's energy. Since natural gas is imported, supplies are vulnerable to damage to infrastructure cause by climate and weather events, as well as local erosion and landslide risks. The energy sector, along with buildings and transport is one of the largest contributors to fossil fuel consumption in North Macedonia. (2,7,9,14,16).

Climate Stressors and Climate Risks ENERGY	
Stressors	Risks
Increased temperatures	Decreased hydropower output and reliability
Increased drought frequency and duration	Damage to energy infrastructure
Decreased water availability	
More frequent and severe floods	Increased energy demand

## ECOSYSTEMS

With a diverse topography and varied climate, North Macedonia is considered a hotspot of biodiversity in Europe, with over 16,000 species recorded, including 854 endemic species. Endemic species, particularly those restricted to subalpine and alpine zones, are vulnerable to a changing climate. Forty percent of the country is forested, primarily with various species of oak and beech trees, with a small portion, mostly at higher elevation, coniferous. Ninety percent of the forested land in the country is state owned and managed by special public enterprises or local government offices. Increased temperatures and

Climate Stressors and Climate Risks ECOSYSTEMS	
Stressors	Risks
Increased temperatures	Increased risk of forest fires
Increased frequency and duration of drought	Reduced forest productivity
	Increased erosion and landslide risk
More frequent and severe floods	Degradation of wetland habitats

decreased precipitation will likely lead to a much higher risk of forest fires. Approximately 2,800 forest fires have occurred between 1999 and 2012, burning almost 130,000 hectares of forested land, with damages estimated at around \$78 million. With such a diversity of species, there is always potential for great loss during forest fire events. While it is unclear how well North Macedonia's forests are adapted to fire, in general beech are later succession species than oak, which means they are likely to recover slower after a disturbance like fire. Regardless, a change in fire regime could dramatically alter ecosystem composition and function. The lake and wetland ecosystems of Lake Dojran in the southeast, and Ohrid and Prespa in the southwest are very vulnerable to disturbances in the water regime. Dramatic losses in both flora and fauna have been recorded during previous drought events and can be expected to continue as precipitation decreases and temperatures increase. Riparian habitats in the country are also under significant threat from changing climate conditions. Located primarily in the Varder valley, these habitats are vulnerable to both flooding and drought. (4,5,7,8,13,14,17)

## EDUCATION

North Macedonia lags behind many transitional countries in education performance and inclusion of people with disabilities in mainstream education. Additionally, educational instruction has historically been separated along ethnic lines (e.g., primary school through universities with instruction delivered in North Macedonian or Albanian). Marginalized groups are often both those with the least educational opportunities, and those most vulnerable to climate change. In North Macedonia it is also possible the rural poor will have less access to resources such as clean water and nutritional food due to less precipitation, which could further limit educational progress. There is also risk that climate sensitive sectors, such as agriculture, which 17% of the country relies on for income, becomes less sustainable and schools that focus on agriculture topics may have to shift curriculum accordingly. Negative health impacts, such as potential increased exposure to diseases, and negative impacts on education related infrastructure, may also have undesirable impacts on overall education quality. Moving forward, it will be important that the Ministry of Science and Education continues to focus on inclusive access to quality education so that marginalized groups are not disproportionately effected by extreme weather events, less precipitation, and other climate stressors.

Climate Stressors and Climate Risks EDUCATION	
Stressors	Risks
<b>Decreased overall precipitation</b>	Lack of food security, increased health issues, and decreased ability of vulnerable groups to focus on education
<b>Potential increase in extreme weather events</b>	Damage to key education infrastructure, such as schools and roads to access schools
<b>Increased temperatures</b>	Increased risk of forest fires, causing students to miss schools in areas impacted

## POLICY CONTEXT

### INSTITUTIONAL FRAMEWORK

North Macedonia's Ministry of Environment and Physical Planning (MOEPP) is the primary governmental body in development of climate and climate related policies. MOEPP is the Designated National Authority for global climate agreements and the National Focal Point to the UNFCCC. Other national bodies responsible for implementing climate policies include the Ministry of Agriculture, Forest and Water Management, Ministry of Economy, Ministry of Transport and communication, and Ministry of Finance. These agencies are responsible for integrating climate policies, strategies, and programming into their respective focus areas. In 2000, MOEPP established the Climate Change Project Office, along with a National Climate Change Committee, consisting of stakeholders from government, academia, civil society, and the private sector.

This committee is tasked with providing high-level support and guidance for climate policy at the country level. Major actions carried out by these climate focused bodies include the three national communications on climate change, the design of a national GHG emissions inventory, and developing Nationally Determined Contributions, which outlined greenhouse gas emissions reductions targets as part of the 2015 UNFCCC Paris Agreement which describes countries' commitments to mitigate climate change. North Macedonia has also released two Biennial Update Reports (BURs) on climate change, the most recent in 2017, which update GHG inventories and mitigation actions, but also highlighted the lack of a comprehensive national adaptation plan for the country. (6,7,8,9,10,11,12)

### KEY RESOURCES<sup>2</sup>

1. Bergant, K. 2006. [Climate Change Scenarios for Macedonia Summary](#).
2. Climate Service Center Germany. 2012. Climate-Fact-Sheet Macedonia.(
3. European Environment Agency. 2018. [Global and European Temperature Assessment](#). Accessed October 9, 2018.
4. Nowacki GJ, Abrams MD. 2008. [The Demise of Fire and 'Mesophication' of Forests in the Eastern United States](#).
5. Regional Environmental Center for Central and Eastern Europe. 2015. [Forest Fire Country Studies – Former Yugoslav Republic of Macedonia](#).
6. Republic of Macedonia Ministry of Environment and Physical Planning. 2003. First National Communication on Climate Change.
7. Republic of Macedonia Ministry of Environment and Physical Planning. 2009. [Second National Communication on Climate Change](#).
8. Republic of Macedonia Ministry of Environment and Physical Planning. 2013. [Climate Change Communication Strategy and Action Plan](#).
9. Republic of Macedonia Ministry of Environment and Physical Planning. 2014. [Third National Communication on Climate Change](#).
10. Republic of Macedonia Ministry of Environment and Physical Planning. 2015. [First Biennial Update Report on Climate Change](#).
11. Republic of Macedonia Ministry of Environment and Physical Planning. 2015. [Nationally Determined Contributions to the UNFCCC](#).
12. Republic of Macedonia Ministry of Environment and Physical Planning. 2015. [Second Biennial Update Report on Climate Change](#).
13. United States Agency for International Development. 2018. USAID Macedonia Strategic Framework FY2018-2020.

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<sup>2</sup>This "Key Resources" section lists works cited in preparing the Climate Risk Profile.

### NATIONAL STRATEGIES AND PLANS

- [First National Communication on Climate Change](#) (2003)
- [Second National Communication on Climate Change](#) (2009)
- [Climate Change Communication Strategy and Action Plan](#) (2013)
- [Third National Communication on Climate Change](#) (2014)
- [Greenhouse Gas Inventory](#) (2014)
- [Nationally Determined Contributions to the UNFCCC](#) (2015)
- [First Biennial Update Report on Climate Change](#) (2015)
- [Second Biennial Update Report on Climate Change](#) (2017)

14. United States Central Intelligence Agency. 2018. [World Factbook – Republic of Macedonia.](#)
15. World Bank Group. 2010. [Climate Change and Agriculture Country Note.](#)
16. World Bank Group. 2012. [Macedonian Green Growth and Climate Change Analytic and Advisory Support Program Briefing Note.](#)
17. World Bank Group. 2013. [Reducing the Vulnerability of the Former Yugoslav Republic of Macedonia’s Agricultural Systems to Climate Change Impact Assessment and Adaptation Options.](#)
18. World Bank Group. 2018. [Climate Change Knowledge Portal – Republic of Macedonia.](#)
19. World Banks Group. <https://data.worldbank.org/>. Accessed October 9, 2018.

Map resource: Global Precipitation Climatology Centre (GPCC). 2015. GPCC Normal Version 2015 0.25 degrees. <https://kunden.dwd.de/GPCC/Visualizer>

## SELECTED ONGOING EXPERIENCES<sup>3</sup>

Projects below represent current or recently completed development efforts related to climate change in North Macedonia. Projects were selected through review of USAID, other donors, and implementing partners project databases.

Selected Program	Amount	Donor	Year	Implementer
<a href="#">Municipal Climate Change Strategies Project</a>	\$2.8 million	USAID	2012-17	Milieukontakt Macedonia
<a href="#">Adaptation to Climate Change in Agriculture</a>	\$1.6 million	USAID	2012-16	Rural Development Network of the Republic of Macedonia

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<sup>3</sup> This “Selected Ongoing Projects” section lists a selection of ongoing development projects and interventions directly or indirectly relevant to climate risk management and adaptation in North Macedonia. Projects were identified primarily via desk review of USAID, multi-lateral development bank, and other international donor programming. Projects listed are not meant to be comprehensive.