WATER-RELATED CLIMATE HAZARDS IN GEORGIA

Introduction

Georgia is increasingly vulnerable to climate-related water hazards due to its geographic and climatic diversity. The country experiences both prolonged dry periods and extreme precipitation events. This report focuses on three key hazards—droughts, floods, and heatwaves—based on their projected severity, economic impact, and relevance to Georgia's primary sectors, including agriculture, hydropower, and urban infrastructure.

The report differentiates between three hazard severity categories[1] – low, medium and high – and provides a projected probability of occurrence for each of these categories for each year in the period 2024-2100. To display the range of future scenarios, three climate change scenarios are used: SSP5-8.5 (high-emission scenario), SSP2-4.5 (moderate-emission scenario), SSP1-2.6 (low-emission scenario).

Key hazards identified

The research identified three primary hazards: droughts, riverine floods and heatwaves. The findings indicate that these hazards are expected to worsen under SSP5-8.5 and SSP2-4.5 scenarios, while they may improve under SSP1-2.6 by 2100. The likelihood of their occurrence will correspondingly increase or decrease. Hence, the impacts of these climate hazards vary significantly depending on emission pathways. Under SSP1-2.6, where strong mitigation efforts are implemented globally, the likelihood of extreme droughts, floods, and heatwaves remains relatively stable, with only minor increases from historical baselines. Under SSP2-4.5, moderate warming leads to more noticeable but still manageable increases in hazard frequency and intensity. In contrast, under SSP5-8.5, Georgia faces a future where extreme climate events become the norm, with heatwaves occurring nearly every summer, medium-severity floods occurring every three years instead of every ten, and severe droughts becoming twice as likely as they are today.

Droughts are projected to become more frequent and severe, particularly in eastern Georgia. Under high-emission scenarios (SSP5-8.5), the probability of low hazard meteorological droughts could rise to 37% by 2100, compared to 20% under moderate-emission scenarios (SSP2-4.5) and 15% under low-emission scenarios (SSP1-2.6) (see Figure 1).

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[1] Hazard severity classification was defined based on a standardized precipitation evapotranspiration index (SPEI) for droughts, composite risk score for floods, and duration for heatwaves.

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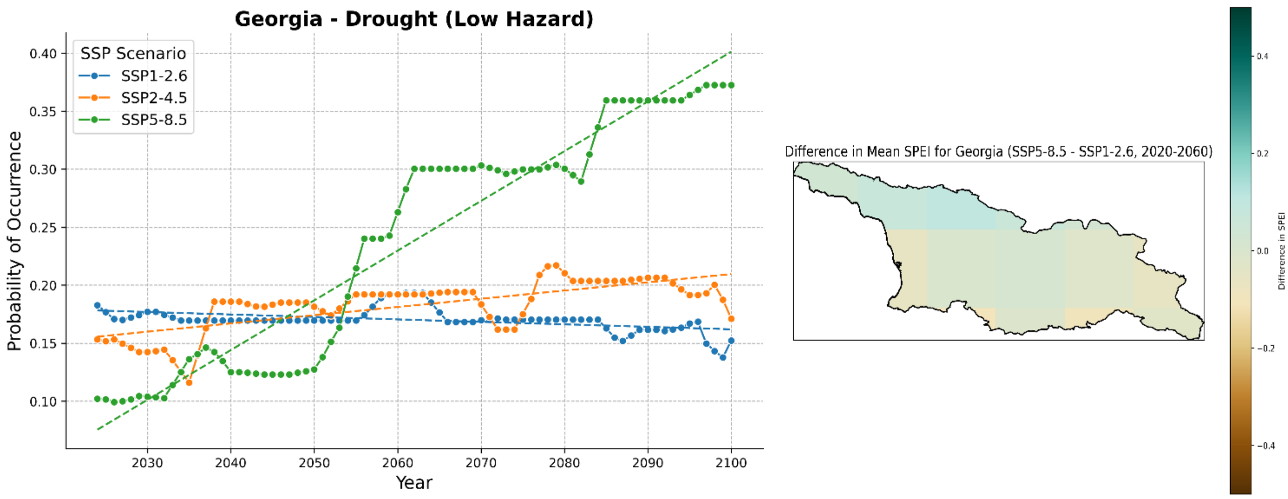
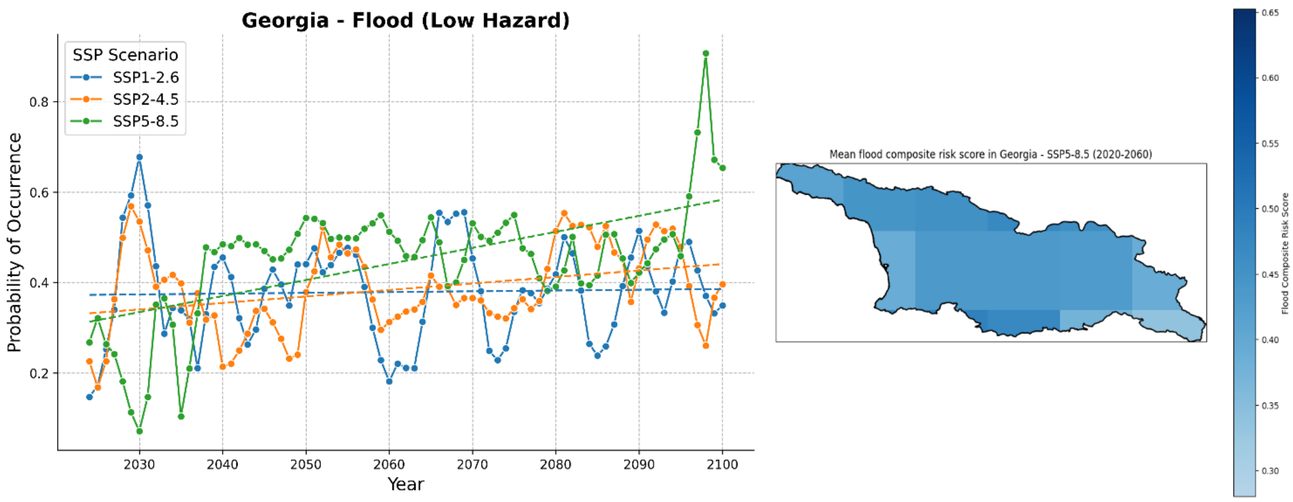
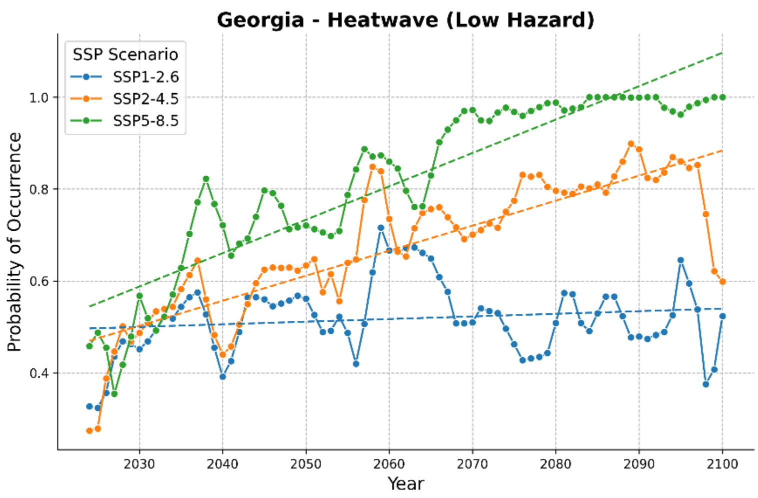
Medium- and high-severity drought events also increase significantly under high-emission pathways, posing a critical threat to agricultural productivity, energy supply through hydropower, and rural livelihoods under all emission scenarios.

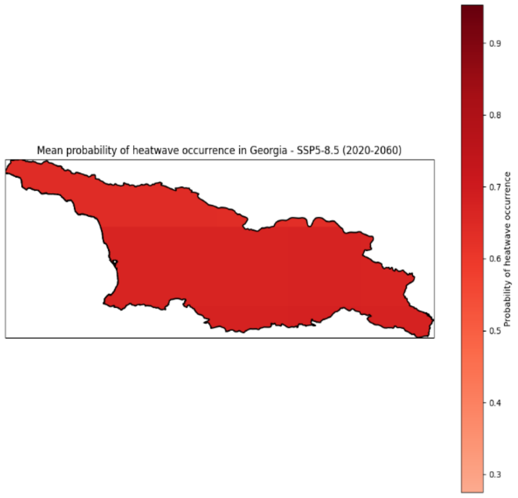


Floods are projected to increase, causing widespread infrastructure damage, displacement, and economic losses. Under SSP5-8.5, the probability of low hazard riverine floods rises to 55-65% by 2100, compared to 40% under SSP2-4.5 and a more stable 35% under SSP1-2.6 (see Figure 2). Medium- and high-hazard floods, which historically occurred once every decade, are projected to become at least three times more frequent under high-emission scenarios. The rising flood risk underscores the urgent need for enhanced flood defences and early warning systems.



Heatwaves have become more frequent and intense. By 2100, under SSP5-8.5, Georgia is expected to experience nearly certain annual heatwave occurrences. The probability of long-duration heatwaves (more than 10 days) is projected to reach 96% under SSP5-8.5, compared to 50% under SSP2-4.5 and 16% under SSP1-2.6 (Figure 3). This dramatic rise in extreme heat events will have serious consequences for human health, agricultural yields, and energy demand, necessitating immediate global mitigation strategies and national adaptation plans.

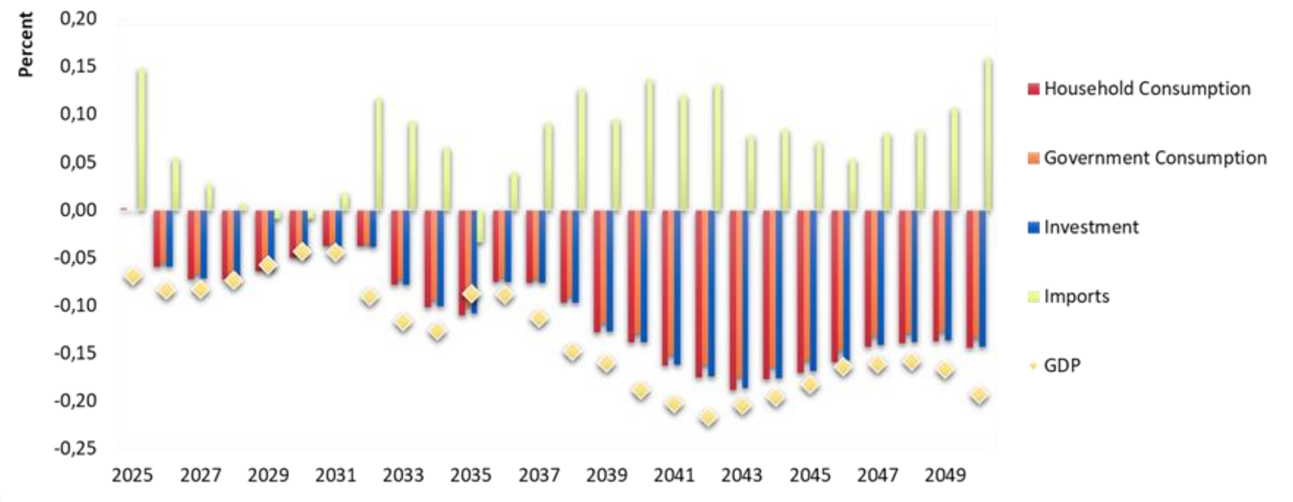




Economic impacts

The agriculture sector, a dominant employer in Georgia, could face severe productivity declines under SSP5-8.5 due to prolonged droughts and heat stress, possibly threatening food security and economic stability. Hydropower generation, which accounts for most of Georgia's electricity production, is at risk due to changing river flows and increased drought conditions, potentially leading to energy shortages and volatility during peak summer demand. Increased flooding under high-emission scenarios could cause widespread damage to infrastructure, displacing communities and driving up maintenance costs for infrastructure.

Economic impacts of climate change – SSP5-8.5 scenario (Source: GWS based on e3.ge)

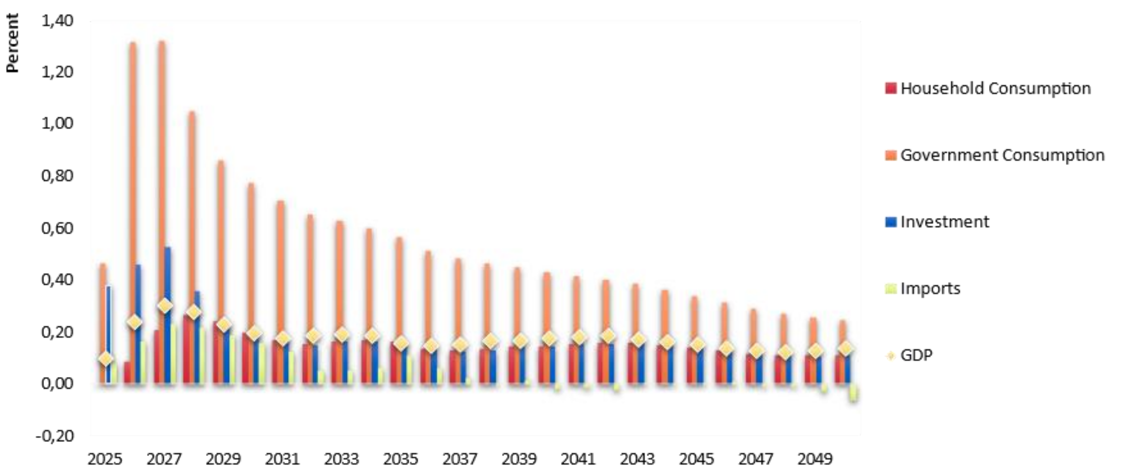


Adaptation strategies

Immediate action is recommended to both mitigate greenhouse gas emissions and adapt to the most likely climatic hazards riverine floods, heatwaves and droughts, to prevent further economic damages. Georgia is advancing the development of multi-hazard risk management plans for 11 river basins that combine both structural and non-structural measures to reduce flood risks in river basins. These plans include the construction of flood protection infrastructure such as gabions, the implementation of flood risk zoning, the adoption of flood-resilient building codes, and the establishment of early warning systems. A macroeconomic analysis carried out by GIZ in collaboration with the Ministry of Economy and Sustainable Development (MoESD) evaluated the broader economic benefits of these adaptation measures.

The findings demonstrate that strengthening resilience to flooding can drive job-rich economic growth, with GDP increasing by up to 0.3% annually and employment by up to 4,400 until 2050.

Economic benefits of flood protection – SSP5-8.5 scenario (Source: GWS based on e3.ge)



According to an analysis of the literature and expert interviews, further possible adaptation measures are the following. The expansion of solar-powered drip irrigation can enhance agricultural resilience to droughts while reducing water consumption. The implementation of real-time flood monitoring and early warning systems will provide critical lead time for disaster response, minimizing damage and loss of life. Investments in climate-resilient infrastructure, integrated water resource management, and strategic land-use planning will be essential to reduce economic losses and ensure long-term sustainability in the face of accelerating climate risks.

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