



# The Future Climate of Guam

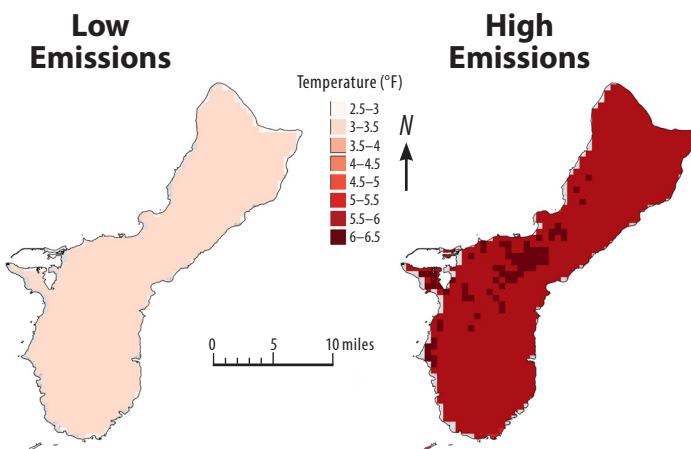
*Hotter conditions are projected by the end of the century*

## How can we project future climates?

A variety of global climate models provide future rainfall and temperature projections for most of the Earth's surface. These models use mathematical equations to describe and predict how increases in temperature (extra energy) will affect the ocean and atmosphere across large areas.

In order to understand how climate may change at specific locations, a technique called Climate Downscaling is often used. This technique translates global model projections for large areas to a finer resolution, which is more useful for local-scale management. Since we don't know exactly what will happen in the future, a range of greenhouse gas scenarios is often supplied. These scenarios are based on the actions of humans and often include: 1) a future where societies across planet Earth are successful in reducing GHG emissions to the atmosphere ("Low Emissions" scenario); and 2) a future where there is no change in efforts to reduce GHG emissions ("High Emissions" scenario).

Understanding how climate is projected to change under these two different scenarios is critical to developing effective management responses including adaptation options for species, ecosystems, watersheds, and human communities.



**Figure 1:** Future end of century (2080–2099) projected changes in temperature on Guam for low (left) and high (right) emissions scenarios<sup>1</sup>.

## Future Climate Change in Guam

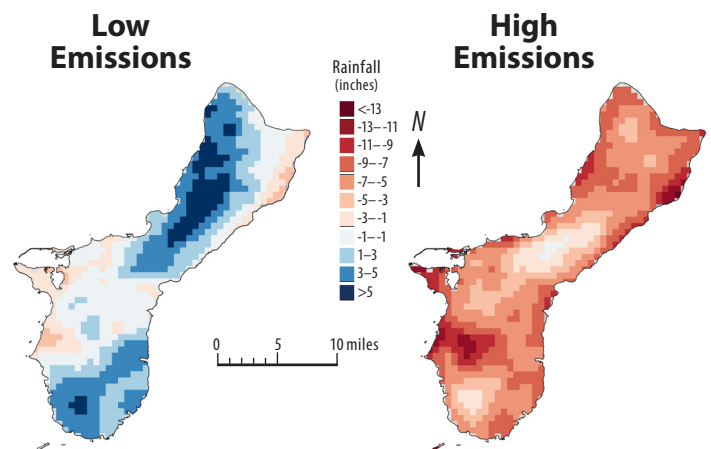
Significant increases in surface-air temperature are projected for all of Guam by the end of the century (2080–2099) under both future emissions scenarios (Figure 1). For the low emissions scenario, average temperatures are projected to increase by 3°F relative to present day (1990–2009). For the high emissions scenario, a 6°F increase is projected.

Regarding future rainfall, a 2% (1.6 in) increase is projected for the low-emissions scenario and a 7% (6.6 in) decrease is projected for the high-emissions scenario (Figure 2). Projected changes in rainfall are not determined to be statistically significant.

Tropical Cyclone frequency around Guam is projected to decrease but the intensity of these storms is projected to increase<sup>1</sup>.

## Impacts

Projected changes in climate have the potential to negatively impact natural ecosystems and disrupt many aspects of life. Future impacts may include: increased incidences of wildfire, decreases in air quality, increased transmission of disease, decreased energy production, reduced water availability, damages to infrastructure (Figure 3), bleaching of coral reefs, a loss of biodiversity, decreased food security and negative impacts on human health<sup>2</sup>.



**Figure 2:** Future end of century (2080–2099) projected changes in rainfall on Guam for low (left) and high (right) emissions scenarios<sup>1</sup>.

## Key Management Actions?

In the face of projected changes in environmental conditions, the role of land managers has never been more important. The following list describes actions that should be considered by managers in various sectors<sup>2</sup>.

### Water Sector

- Monitor salinity levels in aquifers, and plan for reduced groundwater recharge.
- Modify pumping depth and withdrawal rates.
- Increase knowledge and awareness among community members about how water systems can be impacted by climate change.
- Pay attention to seasonal forecasts and El Niño events.

### Public Safety and Health

- Prepare for more heat-related illness and death.
- Plan for increased wildfire that result in respiratory and other health hazards.
- Monitor pathogens in drinking water.
- Improve early warning systems, relocation assistance and disaster relief.
- Pre-planning for disaster recovery to improve resilience.
- Raise public awareness of vector-borne diseases.

### Coastal Infrastructure

- Prepare for more frequent flooding and erosion.
- Incorporate sea-level rise projections into planning.
- Hardening of infrastructure and utilities to mitigate effects of natural hazards.

### Ecosystems and Biodiversity

- Prepare for forest and soil loss from wildfire.
- Monitor for invasive species.
- Promote measures that protect and enhance ecosystem services.
- Implement measures to reduce sediment and pollution on coral reefs.
- Improve land management practices.

### Cultural Resources

- Implement strategies to protect archeological and cultural sites.
- Establish conservation activities to protect culturally significant plants and food.

### Recreation and Tourism

- Monitor coral health and vitality.
- Prepare for beach loss and decreased water quality after flooding events.
- Reduce bacterial pollution that causes visitors to avoid beaches.

### Finance and Economic development

- Research and prepare for the impacts of climate change on customers, employees, communities, supply chain and business models.
- Monitor and research innovative insurance mechanisms to manage climate-related risks.



**Figure 3:** A house next to the Umatac Bridge along Route 2 is flooded as the river nearby crests on Aug. 27, 2020.

Credit: Post file photo.

[www.postguam.com/news/local/report-climate-change-will-disrupt-guamanians-lives/article\\_84301e96-2336-11eb-aa95-f34ea00401d9.html](http://www.postguam.com/news/local/report-climate-change-will-disrupt-guamanians-lives/article_84301e96-2336-11eb-aa95-f34ea00401d9.html)

### Food Systems

- Research and development of smart farming methods.
- Plan for warmer weather by moving crop locations and managing disease.
- Plan for reduced available catch for subsistence fishing.

### Education

- Plan for greater heat-related illness to students.
- Make school facilities more resilient to extreme weather events.

New innovative approaches will be required to perpetuate our natural and cultural resources in the long-term. In addition, continued and improved cooperation between the U.S. government and the government of Guam will be key in successfully adapting to projected future changes in climate. Proactive planning and preparation can help alleviate the burden placed on society and the people of Guam and help them to both build resilience and adapt to change.

### Acknowledgements

The National Weather Service of Guam for their critical scientific review

<sup>1</sup> Wang, et al., (2016). 21st Century High-Resolution Climate Projections for Guam and American Samoa <https://www.sciencebase.gov/catalog/item/50118ddce4b0d78fd4e59ba3> Note: Wang et al. (2016) utilized a high resolution (0.8 km) regional atmospheric model to dynamically downscale the results of Coupled Model Intercomparison Project 5 (CMIP5) global coupled models to project the anticipated 21st century changes in rainfall, surface air temperature.

<sup>2</sup> Grecni et al. (2020). Climate Change In Guam DOI:10.5281/zenodo.4037481

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