

Geoscience Protecting the Public

GEOSCIENCES IMPACT ON PUBLIC SAFETY AND WELLNESS

The geosciences, which address issues across air, land, and oceans, are key to the United States' approach to managing natural hazards and improving public and environmental health. Geoscience uses mapping and analysis of Earth's complex systems to provide vital data that helps with emergency readiness and climate adaptation strategies. For example, precise weather forecasts allow for proactive actions to minimize natural disaster impacts, lowering potential damage to communities. Long-term environmental observations help detect changes in climate trends, directing public health actions to deal with emerging issues such as heatwaves or the spread of infectious disease. Also, geoscience research supports urban planning and infrastructure development, reducing risks

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from sea-level rise, drought, earthquakes, and other geophysical hazards. These scientific findings are important for anticipating and alleviating the impacts of natural disasters such as wildfires, which affect air quality and create serious respiratory health problems. Moreover, the study of Earth's systems helps tackle the problems caused by mineral dusts and environmental pollutants, especially in urban areas where industrial activity and high population density increase exposure risks. The incorporation of geoscientific research into public policy and health initiatives is essential for predicting, coping with, and recovering from environmental challenges, ultimately protecting economic activity, food supply stability, the environment and citizen well-being.



United States Billion-Dollar Disaster Events 1980-2024 (CPI-Adjusted)

Since 1980 the United States has faced an increased number of natural disaster-related events. Though the economic impacts of these disasters have increased, they have not increased as fast as the frequency of events, partially driven by improved forecasting, risk management, and infrastructure resilience thanks in large part to contributions by geoscientists driving our understanding of these events.

Earthquake Risk Assessment

Geologists and seismologists analyze faults and past seismic activity to forecast future earthquake risk, helping to inform building codes, urban planning, and disaster preparedness strategies.

Flood Prediction and Management

Geoscientists study river behaviors, human modifications to channels and weather patterns to predict floods, contributing to the design of flood defenses, and land-use planning to minimize impact on human health and property.

Climate Change Impact Assessments

Climate scientists analyze long-term weather patterns and trends to forecast changes in climate that can affect public health, infrastructure, agriculture, and water supplies, aiding in developing adaptation strategies.

Hazardous Materials Management

The study of how pollutants like heavy metals and chemical wastes behave in the soil and groundwater enables geoscientists to advise on the containment, clean-up, and environmental health impacts of these hazardous materials.

Volcanic Eruption Monitoring

By studying volcanoes, geologists can predict eruptions and provide warnings to minimize loss of life and health impacts from ash, gases, and landslides, which are critical for nearby communities, the safety of air transport. Volcanoes can impact global weather and thus agricultural productivity.

Wildfire Risk and Management

Through the study of landscape, ecology, and fire history, geoscientists help predict wildfire occurrences and develop strategies for controlled burns and land management that reduce the risk of large, uncontrollable fires, thereby protecting air quality and reducing the risk of landslides and erosion of valuable soils.

Air Quality Monitoring

Geoscientists play a role in studying how natural events like dust storms and volcanic eruptions affect air quality. They also examine the dispersion of pollutants in urban areas, which is essential for public health advisories and regulatory measures.

Coastal Erosion and Sea Level Rise

Oceanographers, geomorphologists, and geophysicists help predict changes in sea levels and storm surges, which are vital for coastal urban planning, protecting water quality, preserving ecosystems, and preventing loss of life from flooding.

EXEMPLARS OF IMPACTS OF GEOSCIENCE ON NATURAL HAZARDS AND PUBLIC HEALTH

Geoscientists, particularly seismologists and oceanographers, play a vital role in the development and operation of tsunami warning systems. These systems utilize networks of seismic and ocean sensors to detect undersea earthquakes that could potentially trigger tsunamis. By analyzing the seismic activity and water column changes in real-time, geoscientists can predict the arrival times and potential impact of tsunamis on coastal areas. This early warning capability is crucial for evacuating populations at risk, thus saving lives and reducing Loss of infrastructure from these destructive natural events.

Geoscientists contribute significantly to monitoring and improving urban air quality by studying the sources and dispersion patterns of pollutants. This involves tracking particulates from both natural sources, like volcanic ash, and human-made sources, such as vehicle emissions and industrial pollutants. By modeling how these particles travel through the atmosphere under various weather conditions, geoscientists help public health officials develop strategies for reducing exposure to harmful air pollutants, advising on the best times for outdoor activities and guiding policies on emissions reductions. Hydrogeologists specialize in understanding the movement and storage of groundwater. Their expertise is crucial in preventing groundwater contamination, a major public health issue, especially in areas dependent on well water. By mapping aquifers and identifying contamination risks from agricultural runoff, industrial processes, and improper waste disposal, hydrogeologists help design effective safeguards and remediation strategies. These measures ensure the safety of drinking water supplies and protect aquatic ecosystems from the harmful effects of pollution.



CASE STUDIES

Following major wildfires in the Western United States, the U.S. Geological Survey conducts hazard assessments to map the potential for post-fire debris flows. This geoscientific activity is crucial for emergency response and urban planning, as it predicts areas at risk of mudslides after a wildfire, thus protecting lives and property by facilitating timely evacuations and infrastructure protections.

Geoscientists contribute to hurricane preparedness by mapping coastal vulnerabilities to sea-level rise and storm surges. Tools like the Delaware Coastal Flood Monitoring System that produces interactive inundation maps illustrate potential flooding scenarios under various sea level conditions, storm surge, and tidal conditions, aiding in the strategic planning for coastal infrastructure and community safety measures against hurricanes and coastal flooding and provide knowledge on risk assessment in support of land use planning.

In the Northeastern United States, increased frequency of wildfires due to climate change poses significant risks. Geoscientists work on forecasting the occurrence and spread of wildfires, enabling better preparedness and response strategies that help protect public health and community resilience. The Northeast-Midwest Wildfire Risk Assessment Portal provides comprehensive data, user-friendly applications, and planning tools aimed at wildfire risk reduction. This tool helps federal, state, Tribal, and local communities prioritize areas for mitigation treatments, community education, and tactical analyses to effectively manage and reduce the risks associated with wildfires. The portal is a collaborative effort to streamline wildfire management across diverse jurisdictions in the Northeast and Midwest U.S.

In highly seismic zones, geoscientists assess and map earthquake risks, helping cities like Los Angeles

to develop and enforce building codes that improve infrastructure resilience. By predicting the intensity and superimposing this risk relative to key geologic features such as rock type, potential impacts of seismic activity are determined which can be used to significantly reduce the risks to human life and health in earthquake-prone areas. The USGS Shake-Alert[®] earthquake early warning system operating tin the northwest U.S. provides a warning message in the critical seconds before the shaking arrives from a strong earthquake.

Geoscientists play a key role in flood risk management by mapping and modeling how water flows through landscapes and where floodplains are located. They combine data from different sources, such as topography, hydrology, and meteorology, to forecast where and how severe flooding might occur. Geoscientists collaborate with urban planners and civil engineers to develop infrastructure such as dams, levees, and drainage systems that can reduce the effects of floods. They also assist in community planning efforts, ensuring that development projects are strategically situated to avoid high-risk areas. This proactive planning is essential for lowering economic losses and protecting communities, especially in areas that are susceptible to sudden or severe flooding events. For instance, the Ala Wai Canal Flood Risk Management Project is a comprehensive effort to lessen flooding risks in the Ala Wai Watershed, which encompasses the economically vital Waikīkī District. This area is not only a major tourist attraction but also a significant economic center for the state of Hawaii. The U.S. Army Corps of Engineers, along with state and local partners, has been conducting a detailed study and plan to enhance flood conveyance infrastructure, which is crucial due to the high risk of flooding from aging systems. This project is vital for safeguarding a densely populated and economically important area from disastrous flooding events.



EXAMPLES OF RELEVANT LEGISLATION AND POLICY

Executive Orders

- 14008: This order is comprehensive, focusing on integrating climate resilience into U.S. foreign policy and national security, establishing a White House Office of Domestic Climate Policy for a coordinated approach to climate challenges, and emphasizing the restoration of scientific integrity across federal decision-making. It highlights the need for clean energy transitions and environmental justice.
- 13990: Signed to ensure science-based decision-making in federal agencies and to address the health and environmental impacts of industrial pollution. It specifically directs the review and potential revision of regulations related to public health and environmental protections, including those impacting air and water quality.

Congressional Legislation

- 117th H.R. 3684 Infrastructure Investment and Jobs Act: This major legislation includes provisions for climate resilience, clean energy, and water system improvements. It represents significant federal investment aimed at enhancing infrastructure in ways that also address environmental challenges.
- **117th**—**H.R. 5376 Inflation Reduction Act:** Enacted in August 2022, this legislation commits nearly \$369 billion to climate and clean energy efforts. It's designed to reduce emissions, promote clean energy use, and enhance environmental justice initiatives through various funding mechanisms and tax incentives.
- 118th H.R. 7916 Removing Nitrate and Arsenic in Drinking Water Act: Amend the Safe Drinking Water Act to provide grants for nitrate and arsenic reduction projects.

Relevant Federal Agencies

- ▶ U.S. Geological Survey
- Federal Emergency Management Agency
- Environmental Protection Agency

Key National Academy Reports

- Affordability of National Flood Insurance Program
 Premiums: Report 2 (2016)
- Assisted Resettlement and Community Viability on Louisiana's Gulf Coast: Proceedings of a Workshop (2023)
- Benefits, Applications, and Opportunities of Natural Infrastructure: Proceedings of a Workshop—in Brief (2022)
- Climate Resilience and Benefit-Cost Analysis: A Handbook for Airports (2019)
- Framing the Challenge of Urban Flooding in the United States (2019)
- Implications of the California Wildfires for Health, Communities, and Preparedness: Proceedings of a Workshop (2020)

Non-Partisan Non-Profit Expertise

- American Geophysical Union
- American Institute of Hydrology
- American Institute of Professional Geologists
- Association of American State Geologists
- Association of Environmental and Engineering Geologists
- Geological Society of America
- National Groundwater Association
- Soil Science Society of America
- Seismological Society of America
- U.S. Permafrost Association

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