4TH JUNIOR HIGH SCHOOL
OF MYTILENE

Water Disasters

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WATER DISASTERS

While being the most precious element in nature, water is also related to enormous disasters, which can result in loss of human lives or in financial losses. Giant waves and excessive rainfall can be as destructive as the sheer shortage of water, which happens in a drought. A place could be significantly damaged for a long time once such an event occurs. Therefore, humans must learn about these disasters in order to comprehend why they occur and how to protect from them. Below are listed six of the most important “water disasters” (tsunamis, drought, floods, ice storms, avalanches and hailstorms):

1. TSUNAMIS

Tsunamis, also known as seismic sea waves, are caused by sudden changes in the seafloor, generally earthquakes and more rarely large landslides. When these events occur under the water, huge amounts of energy are released as a result of quick upward bottom movement. To generate a tsunami, an earthquake must occur under or near the ocean, be large, and create vertical movements of the seafloor. When this happens, huge volumes of ocean water are pushed upward and a wave is formed. It is thought that tsunami-genic earthquakes release their energy over a couple of minutes. All oceanic regions of the world can experience tsunami, but the Pacific Ocean is especially vulnerable because of the many large earthquakes associated with the "Ring of Fire" along its margins.

In the deep ocean, tsunamis' heights are merely a few centimeters, and they have wavelengths of up to 1000 kilometers, and speeds of more than 800 kilometers per hour (the speed of a jetliner). The slope of a tsunami surface at sea is only about a centimeter per kilometer. A tsunami may take 4-6 hours to reach Hawaii from the Aleutian Islands, 7-8 hours from Japan, and 14-15 hours from Chile, but its energy will only dissipate slightly as it crosses the entire ocean. It is easy to see that at these scales the Pacific Ocean becomes like a pond to the tsunami.

A tsunami carries an enormous amount of energy that is spread over a large volume of water in the deep sea. However, when a tsunami reaches shallow water, such as a coastline, the energy is concentrated into a smaller volume and the wave's power overwhelms whatever is in its path. In shallow water, its speed decreases and its amplitude increases to dangerous heights, sometimes 15 m. or higher, and it spreads inland many meters (in some cases two kilometers or more). A tsunami is not a single wave, but a set that may last for several hours, and the first wave is not always the largest.

How big do they get?

In the open ocean tsunamis may appear very small with a height of less than 1 meter. Tsunamis will sometimes go undetected until they approach shallow waters along a coast. These waves have a very large wavelength (up to several hundred kilometers) that is a function of the depth of the water where they were formed. Although these waves have a small height, there is a tremendous amount of energy associated with them. As a result of this huge amount of energy, these waves can become gigantic as they approach shallow water. Their height, as they crash upon the shore, depends on the underwater surface features. They can be as high as 30 meters or more.

How fast do they move?

In the deep open sea, tsunamis move at speeds approaching a jet aircraft. As they approach the shore, they slow down. When a tsunami arrives at the shore, it usually does so as a rapidly rising tide moving at about 70 km/hour.

How much destruction do they cause?

Apart from the tremendous destruction of life that tsunamis cause, they also trigger massive physical damage. They have entirely destroyed buildings and left towns looking like a nuclear war zone. They have lifted boats high out of the water and violently hurled them against the shore, smashing them to pieces. They have bent parking meters all the way down to the ground. In one incredible story, during the huge tsunami in Lituya Bay, Alaska, a boat with two people in it was carried from the bay, over tree tops and over the land out into the ocean. The people survived to tell the tale.

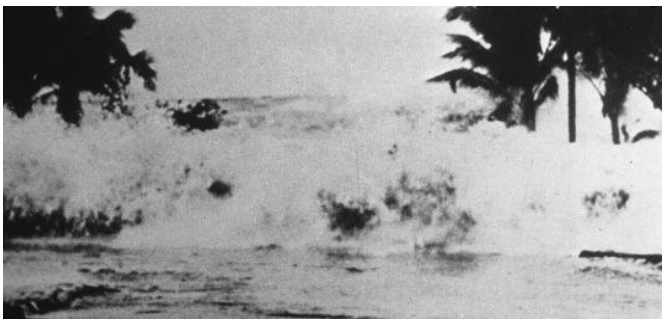
Can we detect them before they hit?

Yes. About 35 years ago, 24 countries around the Pacific set up the Pacific Tsunami Warning System. A group of seismic monitoring stations and a network of tide gauges are used for detection. The biggest problem with this system is that it is difficult to predict how large and destructive the resulting waves will be. Scientists are currently working on better predictive tools.

Drawbacks can serve as a brief warning. People who observe drawback can survive only if they immediately run for high ground or seek the upper floors of nearby buildings. A few minutes' delay might be fatal.

Famous tsunamis

◆ On the night of July 9, 1958 an earthquake along the Fairweather Fault in the Alaska Panhandle loosened a huge mass of rock high above the northeastern shore of Lituya Bay. This mass of rock plunged down into the waters of Gilbert Inlet. The impact generated a local tsunami that crashed against the southwest shoreline of Gilbert Inlet. The wave hit with such power that it swept completely over the spur of land that separates Gilbert Inlet from the main body of Lituya Bay. The wave then continued down the entire length of Lituya Bay, over La Chaussee Spit and into the Gulf of Alaska. The force of the wave removed all trees and vegetation from elevations as high as 524 meters above sea level. Millions of trees were uprooted and swept away by the wave. This is the highest wave that has ever been known.



◆ Japan was hit by a 9.0 magnitude earthquake on March 11, 2011, that triggered a deadly 23-foot tsunami in the country's north. The giant waves deluged cities and rural areas alike, sweeping away cars, homes, buildings, a train, and boats, leaving a path of death and devastation in its wake. Video footage showed cars racing away from surging waves. The earthquake—the largest in Japan's history—struck about 230 miles northeast of Tokyo. According to the official toll, the disasters left 15,839 dead, 5,950 injured, and 3,642 missing.

◆ On July 17, 1998, a Papua New Guinea tsunami killed approximately 2,200 people. A 7.1-magnitude earthquake triggered an undersea landslide, which instantly generated a tsunami about 15 metres tall. The villages of Arop and Warapu were destroyed.

◆ The 2004 Indian Ocean earthquake triggered a series of lethal tsunamis on December 26, 2004, that killed approximately 230,210 people, making it the deadliest tsunami as well as one of

the deadliest natural disasters in recorded history. The initial surge was measured at a height of approximately 33 meters, making it the largest earthquake-generated tsunami in recorded history.

2. DROUGHT

Drought is the condition of abnormally dry weather in a region where rain is usually expected. This scarcity of rain causes a serious imbalance in the hydrological system which, for example, leads to water-supply reservoirs and wells drying up, which in turn leads to crop damage. Drought severity is measured by its duration, the degree of moisture deficiency and the size of the affected area. Droughts can last from a few weeks (partial drought) to many years.

Some areas tend to be more severely affected by droughts than others. Areas bordering permanently arid regions of the world, at latitudes of about 15-20 degrees suffer catastrophic droughts. This happens because in permanently arid areas warm, tropical air masses become hotter and drier as they reach the earth. When the prevailing westerlies experience a poleward shift in direction, the high pressure affects areas that normally experience seasonally wet low-pressure weather, and a drought follows. The most severe drought of the 20th century, in the African Sahel region which lasted for 12 years was caused by a southward shift in the westerlies. Such droughts can be aggravated by nonclimatic pressures like overcropping, overpopulation, the lack of timely

relief measures, and poor internal and international relations.

Preventive measures against drought

Drought cannot be reliably predicted, however precautionary measures can be taken such as the building of dams and reservoirs, the studying of drought cycles and education to prevent the overgrazing, overcropping and overpopulating of drought-risk areas.

Famous cases of drought

1. In the Ukraine and Volga regions, 250,000 to 5 million perished from starvation due to drought. This happened in 1921-22.
2. In 1936, the Sichuan Province in China suffered the worst drought in the modern history of the area, which caused 34 million farmers to be displaced and 5 million people to starve.
3. In 1936-37 the United States and Canada experienced three waves of drought, which are referred to as “The Dust Bowl”. Because of several factors, this drought had a severe impact on the United States and Canada, resulting in entire districts of the American and Canadian Great Plains being depopulated as people were forced to leave. These migrants were the “Okies” whose experience was recorded in literature and song of the period.

3. FLOODS

A flood is an unusual high-water stage in which water overflows its natural or artificial banks onto normally dry land. Floods can have catastrophic consequences, wreaking uncontrollable havoc. This often happens as a result of excessive rainfall over short periods of time, but can also be caused by ice jams during the spring rise, storm tides and tsunamis. Floods damage property and endanger the lives of humans and animals. They cause soil erosion and the deposition of sediment

which can result in long-term environmental problems such as the destruction of natural habitats and spawning grounds. Floods cause problems with drainage and economic land use, as well as traffic delays and the impairing of navigation and hydroelectric power. Floods cost lots of human lives, not to mention millions of dollars in financial losses each year.

Floods are not always disastrous, however, as in the case of the Nile River before the Aswan Dam was built. The Nile flooded every spring bringing much needed enrichment and moisture to the fertile soil of its floodplains.

Floods can cause great damage to land and water-related constructions which can have disastrous consequences for people and economies, both short and long-term. Thus, it is important to take floods into consideration when planning the construction of bridges and dams, for example, as well as good use of land. For these reasons floods are measured in terms of height, volume of flow and the area submerged so that good flood control measures, such as storage reservoirs and protective levees, can be implemented. Sometimes, however, the discharge volume of a stream varies greatly from month to month and year to year. A flash flood, for example, comes suddenly and unexpectedly, does not last very long and can be extremely dangerous. Another factor to be considered in the design and engineering of structures such as dams and reservoirs that may be affected, are those floods that are expected to occur only once in a hundred or perhaps a thousand years.

Preventive measures against floods

- Improve drainage efficiency.
- Construct pumping stations, tunnels and water gates and make sure that gullies work.
- Construct structures such as flood barriers, which stop excessive amount of water rushing in low grounds.
- In some of the existing water retention basins, although the capacity of draining water from the area is enough in normal circumstances, in time of excessive rainfall, it is necessary to allocate areas to be used as retention basins for detaining such amount of water to prevent flooding in low

areas, road, and streets.

■ Land owners must not construct bridges, fences or other permanent structures across watercourses, nor should they restrict the flow capacity by constructing erosion protection within the channel.

■ Watercourses must not be used to dispose of debris**,** even seemingly innocuous materials such as grass cuttings**.** Such debris may combine with wind blown debris**,** twigs**,** etc**.** to cause blockage of grills and thus a flooding incident**.**

Famous floods

× On October 1954, in Ontario, Hurricane Hazel induced the worst flooding in the Toronto area in more than 200 years. The toll included 81 dead and more than 20 bridges were destroyed. The estimated damage was $1.03 billion.

× On July 1996, in Saguenay River valley, ten people died and 15,825 people were evacuated when floodwaters washed out thousands of homes, businesses, roads and bridges. The flooding was caused by a sustained downpour of 290 mm of rain over 36 hours. The estimated damage was $1.5 billion.

× On April 1999, in Melita, the flooding of the Souris River washed out roads, damaged bridges in rural areas, and made 800,000 hectares of farmland unseedable. The estimated damage was $103 million.

4. ICE STORMS

What is an ice storm?

Ice can form on a surface when snow partially melts and refreezes. However, ice is most dangerous when it comes in the form of an ice storm. These storms are actually freezing rain (or freezing "drizzle") events that last for an extended period of time, usually from hours to days. Freezing rain is not a type of precipitation, but is instead just rain that freezes to a cold surface. This

occurs in the winter when a layer of warm air develops between a layer of cold air above it and a thin layer of cold air near the ground. As snow falls through the warm layer, it melts into rain drops. Because the cold layer at the ground is thin, it does not freeze before it hits the ground. Instead, it freezes onto the ground itself. When this happens, a continuous sheet of ice on the ground is sometimes referred to as a "glaze" of ice. This ice will continue to accumulate for as long as the freezing rain event remains in the area, usually no longer than a couple of days.

Whenever water freezes onto roads, buildings, and other infrastructure, many hazards quickly present themselves. Ice on roadways greatly reduces traction, resulting in loss of vehicle control and collisions. Transportation delays caused by such conditions can result in millions of dollars of loss to urban economies in just a few days. Pedestrians lose their footing on slippery sidewalks, potentially falling and injuring themselves. Crops and other vegetation can be destroyed, resulting in significant economic losses. However, the greatest threat to both human life and economy during an ice storm are power and communication outages. Accumulations of ice on exposed utility lines can easily weaken and break these structures. The results are often devastating: entire states can be almost entirely without electricity and communication for several days, and sometimes weeks. Ice is also associated with low temperatures which is dangerous to exposed skin, especially when wet from freezing rain or snow.

Where do ice storms occur?

In North America, ice storms are most common in the northern United States and southern Canada, where temperatures above freezing surface are not very common in the winter. In general, mid-latitude regions between 40 degrees and 50 degrees latitude are most susceptible due to the frequent mixing of warm and cold air masses in these regions.

When do ice storms occur?

Ice is a threat to North America between the months of November and April. During this time, warm and cold air masses can mix over the central portion of the continent and provide the necessary conditions for freezing rain events. Besides these events, ice can also cover surfaces by the melting and refreezing of snow. This most frequently occurs during early and late winter when above freezing temperatures are common during the day, but below freezing temperatures still exist at night. Because this ice usually does not persist during the day when people are most active, it is considered slightly less hazardous than ice formed during ice storms, which is usually thicker and more difficult to melt.

How do we cope with ice storms?

The most important aspect of mitigating ice storms is forecasting and issuing warnings, for the purpose of community preparation. Communities can prepare for ice storms by stocking sand and salt to improve roadway and walkway conditions, advising people to use caution when leaving their

homes, and advising people to stock food and batteries before a storm in case they lose power and are not able to leave their homes. In the United States, the National Weather Service issues winter storm warnings and freezing rain advisories when conditions are imminent or favorable for the development of an ice storm.

Famous ice storms

- On December 24, 2000, a three-day storm struck parts of Louisiana, Arkansas, Texas and Oklahoma, resulting in an ice accumulation of 2.5-7.6 cm. Power lines broke, thus leaving 500,000 people without electricity or water. Transportation was limited and planes were not allowed to fly for three days.
- On January of 1998, the "Storm of the Century" in Canada was a freezing rain event that lasted for days, leaving four million people without electricity and costing over $5 billion in structural damage and economic loss combined. Over two dozen people died during this event, and approximately 1000 people were injured.
- A very bad ice storm occured in Tenessee on January 28, 1951. Days after it ended, more than 16,000 homes were deprived of electricity, whereas schools and businesses were closed for three days. Telephone companies could not bring back service and bulldozers were not able to remove the ice from the roads. The estimated damage was 100 million dollars.

5. AVALANCHES

An **avalanche** (also called a snowslide or snowship) is a sudden, drastic flow of snow down a slope, occuring when either natural triggers (earthquakes, movements of animals, loading from new snow or rain), or artificial triggers, such as snowmobilers, explosives or backcountry skiers, overload the snowpack. Avalanches are most common during winter or spring but glacier movements may cause ice avalanches during summer. Avalanches cause loss of life and can destroy settlements, roads, railways and forests. Typically occuring in mountainous terrain, an avalanche

can mix air and water with the descending snow. Powerful avalanches have the capability to entrain ice, rocks, trees, and other material on the slope. Avalanches are primarily composed of flowing snow, and are distinct from mudslides, rock slides and serac collapses on an icefall. In contrast to other natural events which can cause disasters, avalanches are not rare or random events and are endemic to any mountain range that accumulates a standing snowpack. In mountainous terrain, avalanches are among the most serious objective hazards to life and property, with their destructive capability resulting from their potential to carry an enormous mass of snow rapidly over large distances.

Preventive measures against avalanches

They are employed in areas where avalanches pose a significant threat to people, such as ski resorts and mountain towns, roads and railways. The simplest active measure is by repeatedly traveling on a snowpack as snow accumulates; this can be by means of boot-packing, ski-cutting, or machine grooming. Explosives are used extensively to prevent avalanches, by triggering smaller ones that break down instabilities in the snowpack, and removing over burden that can result in larger avalanches. Trees can either be planted or they can be conserved, such as in the building of a ski resort, to reduce the strength of avalanches.To mitigate their effect, artificial barriers can be very effective in reducing avalanche damage.

Famous avalanches

Throughout history, humanity has witnessed many disastrous avalanches, such as the one in Wellington, Washington (March 1910), which is considered the worst avalanche measured in terms

of lives lost in the United States. 96 people were killed.

In the northern hemisphere winter of 1950-1951 approximately 649 avalanches were recorded in a three month period throughout the Alps in Austria, France, Switzerland, Italy and Germany. This series of avalanches killed around 265 humans and was termed the “Winter of Terror”. A relatively recent avalanche is the Galtur avalanche in 1999, which hit the small Austrian village Galtur. The village was thought to be in a safe zone, but the avalanche was exceptionally large and flowed into it, thus killing 31 people.

6. HAILSTORMS

Any thunderstorm which produces hail that reaches the ground is known as a hailstorm. Hail has a diameter of 5 millimetres or more. Hail stones can grow to 15 centimetres and weigh more than 0.5 kilograms. One of the most common regions for large hail is across mountainous northern India, which reported one of the highest hail-related death tolls on record in 1888. China also experiences significant hailstorms. Hailstorms are frequent in central Europe and southern Australia as well. Hail can cause serious damage, notably to automobiles, aircraft, skylights, glass-roofed structures, livestock and most commonly, farmers' crops. Rarely, massive hailstones have been known to cause concussions or fatal head trauma. Hailstorms have been the cause of costly and deadly events throughout history. One of the earliest recorded incidents occurred around the 9th century in India. The largest hailstone in terms of diameter and weight ever recorded in the United States fell on July 23, 2010 in Vivian, South Dakota; it measured 20 cm in diameter and 47.3cm in circumference, weighing in at 0.88kg.

Other famous hailstorms

- On 12 July 1984, tennis ball sized hail fell on Munich and surrounding areas. It was the greatest loss event in the history of the German insurance industry: 200,000 cars were damaged and the storm cost an estimated 166 million Deutschmark.
- The 1995 Mayfest Storm produced $1.1 billion insured losses, and total storm damage was reported at around $2 billion. The storms produced hail about the size of softballs.
- On 19 July 2002, in Henan Province, the People's Republic of China, 25 people died and hundreds were injured due to a hailstorm.

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