YEAR 7 – ATMOSPHERIC OR HYDROLOGIC
YEAR 8 – GEOMORPHIC OR BIOTIC

Dr Susan Bliss

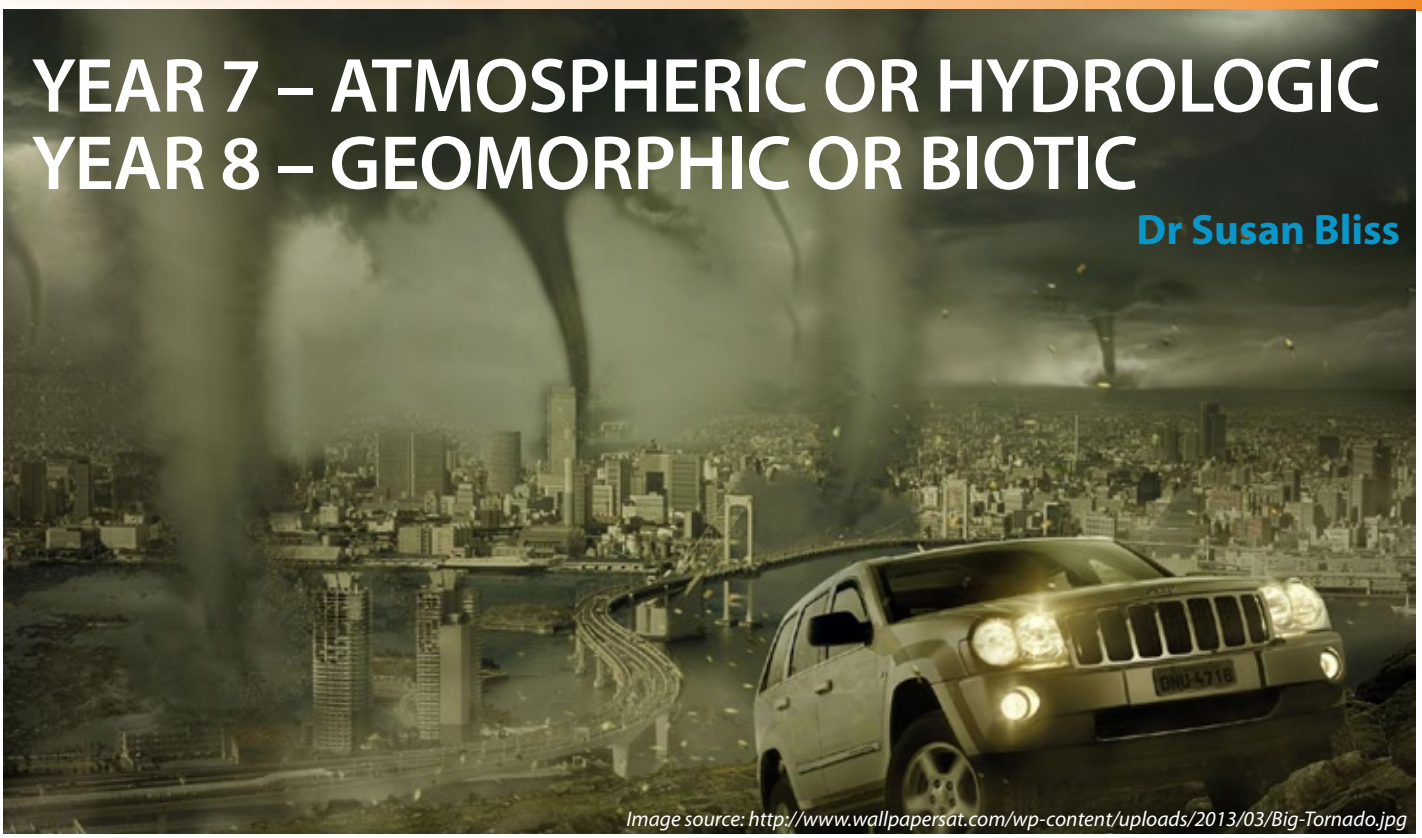


Image source: http://www.wallpapersat.com/wp-content/uploads/2013/03/Big-Tornado.jpg

Curriculum links

Year 7/1 Atmospheric or Hydrologic hazard

- **Elaborations**
  - explaining economic, environmental and social impacts of a selected atmospheric or hydrologic hazard on people and places
  - describing community responses to the hazard
- **Inquiry and skills**
  - using graphs, weather maps and satellite images examine temporal and spatial patterns of a selected hydrologic hazard in Australia, and another region of the world, for example countries of the Asia region

Year 8/1 Geomorphic or Biotic hazard

- **Content Descriptor**
  - causes, impacts and responses to geomorphic hazard
- **Elaborations**
  - investigating the natural causes and spatial distribution of a geomorphic hazard e.g. volcanic eruptions, earthquakes, tsunamis, landslides and avalanches or biotic hazard such as a bushfire that effects a landscape
  - describing how the effects caused by geomorphic hazards are influences by social, cultural and economic factors e.g. where people choose to live, poverty and lack of infrastructure and resources to prepare and respond
  - researching how the principles of prevention, mitigation and preparedness minimises the harmful effects of geomorphic hazards or bushfires

Mother Nature's unexpected acts

- some parts of the planet experience ravaging tornadoes, hurricanes, earthquakes, volcanic eruptions, fires
- damage caused by these hazards are generally unpredictable. In some countries like Australia residents have learned to prepare for these disasters. However, sometimes no amount of planning is inadequate

OVERVIEW YEAR 7 – ATMOSPHERIC OR HYDROLOGIC HAZARDS

GEOWORLD (MACMILLAN)

Hydrological hazards comprise 90 per cent of the world's environmental hazards. The physical causes of hydrological hazards such as droughts, floods and storms such as tropical cyclones, hurricanes, typhoons, blizzards and dust storms, have economic, environmental and social impacts on people and places in Australia and overseas. Human activities have also impacted on the frequency and severity of hydrological hazards. Climate change has significantly affected the water cycle by increasing the temperature and water vapour in the atmosphere. This has changed global circulation patterns and increased the potential for extreme hydrological hazards.

Global overview of extreme storms

Canada ice storm one million people lost power and 25 died

USA dust storms 1930s – Dust Bowl

Iran week long blizzard killed 5,000 people 1972

Myanmar Cyclone Nargis killed 100,000 people 2008

Himalayan Mountain blizzard killed 239 people, India 1996

South India 42 people die in Cyclone Thane, 50,000 thatched huts damaged by winds, 2011

North America winter storm or Groundhog Day Blizzard affected 100million people. Planes grounded, schools closed, power shut down Christmas 2010

East Pakistan – Bangladesh cyclone killed 500,000 to 1 million 1970

Pakistan and Middle East extreme dust storm, 2012

USA in Tornado Alley 1,897 tornadoes killed 552 people, 2011

Bangladesh deadliest tornado killed 1,300 people 1989. Over 2000 people have been killed in 19 tornadoes, almost half of the total for rest of world.

USA Hurricane Katrina one of five deadliest hurricanes in USA, 2005

China dust storm circled world in 13 days in 2009

Coastal Brazil Cyclone Catarina destroyed 1,500 homes and damaged 40,000 others. About 85% of bananas and 40% of rice were lost

China and Asia blizzards: 129 deaths, rooves collapsed, reduced power supply and transport, 2008

Atlantic hurricane season between June and November affects Mexico, Cuba and Caribbean Islands

Western Pacific typhoons most active season with 39 tropical storms 1964

Kampala Uganda 242 days of thunderstorms a year

NW Pacific Ocean, Typhoon Tip most intense storm with air pressure of 870 hectopascals (hPa) and wind speeds of 310km/h 1979

Kereche, Kenya hail falls 132 days a year

China's Typhoon Nina killed nearly 100,000 people in 1975

Western Africa dust plume spanning hundreds of kilometres blew off the coast, 2012

Image source: psdgraphics.com

Far North Queensland coast Cyclone Yasi, devastated region around Cardwell and Tully 2011. Worst cyclone to hit Australia since 1899

East Madagascar at least 16 people killed from Cyclone Giovanna with winds raging at 260km/h, 2012

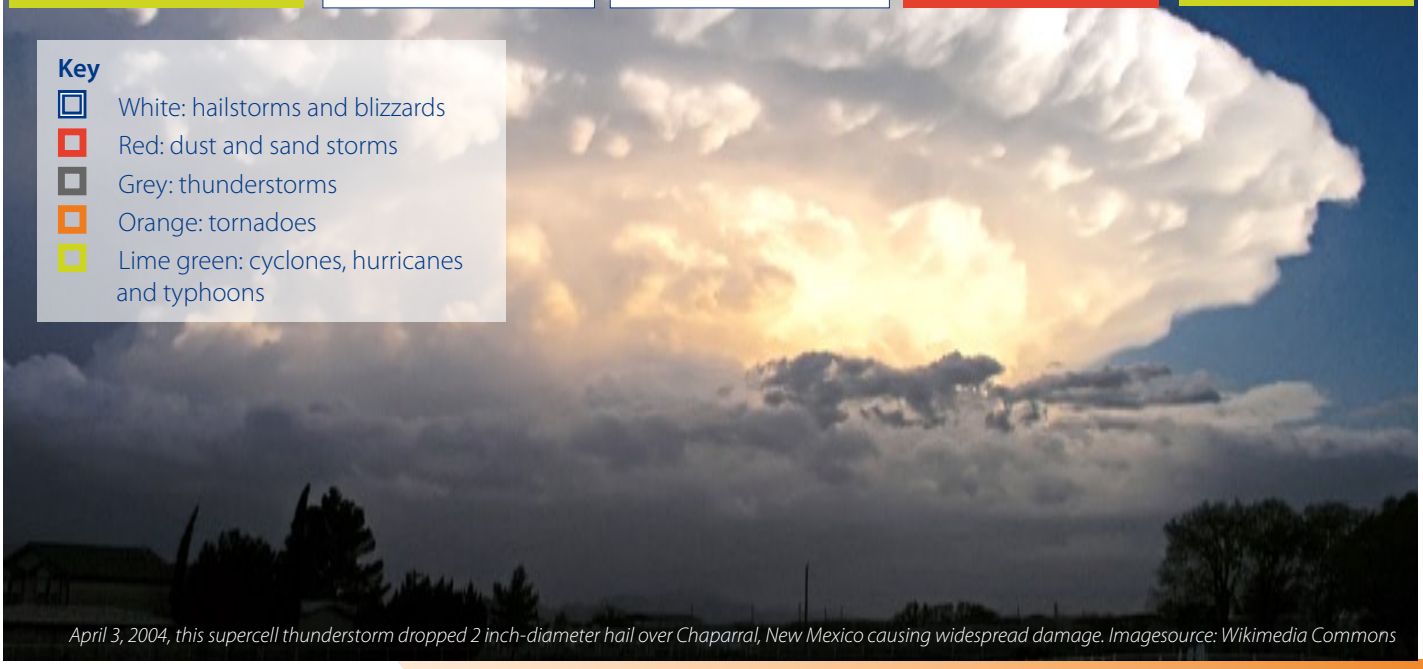
Blizzard Alley Antarctica has hurricane strength snowstorms for weeks, travelling about 60 km/h carrying sleet

Sydney, hailstones up to 90mm in diameter fell for 60 minutes damaging 20,000 buildings and 40,000 vehicles, 1999

Australia dust storm stretched from South Australia, NSW, southern Queensland and New Zealand, 2009

Key

- White: hailstorms and blizzards
- Red: dust and sand storms
- Grey: thunderstorms
- Orange: tornadoes
- Lime green: cyclones, hurricanes and typhoons



April 3, 2004, this supercell thunderstorm dropped 2 inch-diameter hail over Chaparral, New Mexico causing widespread damage. Imagesource: Wikimedia Commons

Natural hazards

Natural hazards can be divided into:

- atmospheric: cyclones, floods, droughts. tornadoes and fires
- geomorphic: volcanic eruptions, earthquakes, landslides, avalanches and tsunamis
- biologic: epidemics and famine

What is a hydrologic hazard?

Hydrological hazards may be classified according to the main processes that create them. Some environmental hazards are caused by several interrelated processes. For example, tropical cyclones cause flooding and trigger mudslides on steep slopes saturated with rainfall. Tropical cyclones also create storm surges that may affect coastal regions.

According to the World Meteorological Organisation (WMO), about 90 per cent of environmental hazards are hydrological in origin. Environmental hazards occur at a range of temporal and spatial scales. They are inevitable and unstoppable events that have been happening for billions of years. Humans have no control over them. However, the world's leading scientists have shown that hydrological hazards are becoming more frequent and more intense at a range of scales due to climate change.

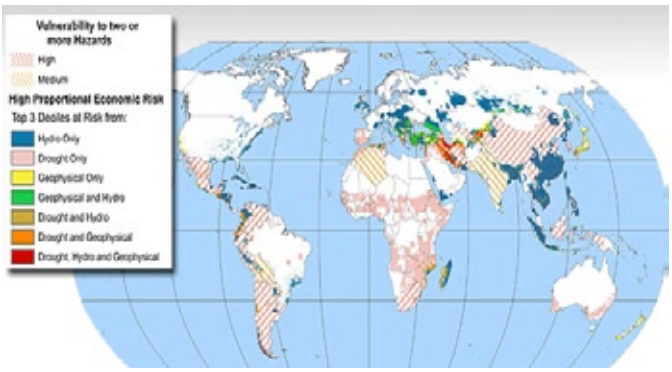
Hydrological hazards may be slow- or rapid-onset events that occur at or near the Earth's surface. Some hydrological hazards such as tornados tend to occur in specific areas while others such as droughts and floods are more widely distributed.

Hazards versus disasters

Hydrological hazards are part of nature. However, if a hydrological hazard leads to loss of human life, damage to property, infrastructure and economic assets, it is classified as a hydrological disaster. Economic losses from hydrological disasters in developing countries are 20 times greater as a percentage of GDP than developed nations.

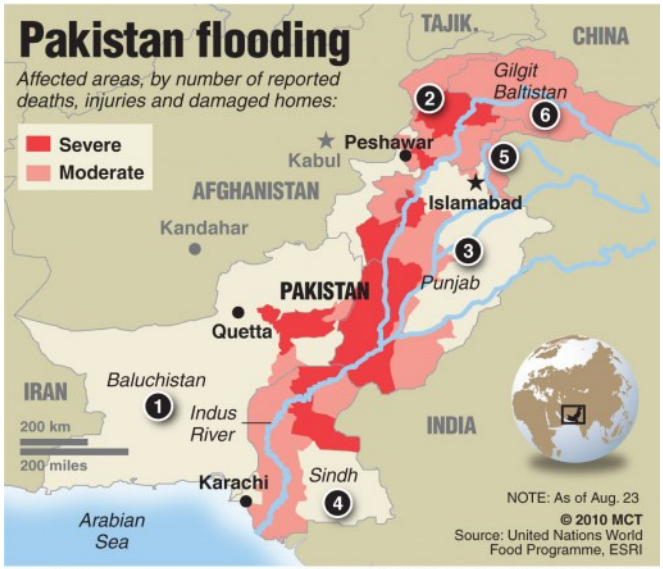
Vulnerability and high proportional economic risk of environmental hazards

Map: Vulnerability to two or more hazards



Source: http://www.worldbank.org/ieg/naturaldisasters/>

Map: Extent of the 2010 flood and its impacts in Pakistan



	Province	Deaths	Houses damaged	Population affected
1	Baluchistan	45	75,261	672,171
2	Kyber Pakhtunkhwa	1,068	179,874	4,365,909
3	Punjab	103	500,000	8,200,000
4	Sindh	71	462,251	3,684,267
5	Azad Jammu and Kashmir	69	6,472	245,000
6	Gilgit Baltistan	183	2,820	8,561
	Total	**1,539**	**1,226,678**	**17,175,908**

Source: http://www.agricorner.com/wp-content/uploads/2010/11/Pakistan-Flood-a.jpg

Impacts of a blizzard on Boston

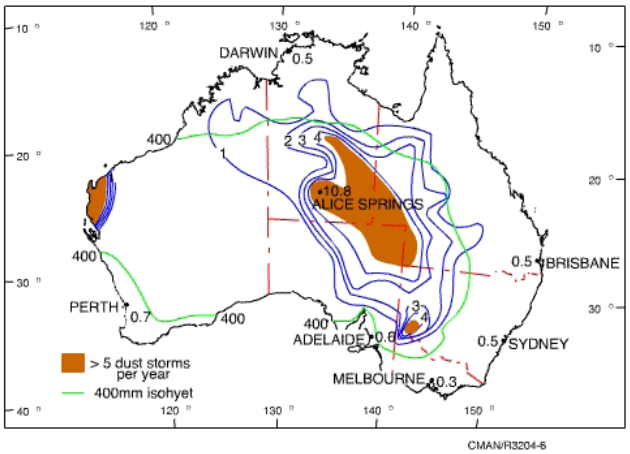
Boston, USA Christmas 2010 (Photo: David Bliss)

Cyclone Nargis, Myanmar and the storm surge

These homes were covered by the storm surge from Cyclone Nargis in 2008

Photo: Marianne Jago, AusAID.
Source: http://www.flickr.com/photos/ausaid_photolibrary/3963694747/

Average dust storms over Australia



Source: http://www.bom.gov.au/lam/climate/levelthree/c20thc/storm8.htm

Economic costs

American financial expert, Warren Buffet claimed that environmental disasters (which consist mostly of hydrological hazards) have a more serious economic impact than terrorism. Extremely large hydrological disasters can cripple a country's economic growth for decades. People need to be rescued, sheltered, fed, watered, clothed and cared for. Law and order needs to be maintained to prevent looting. Power, water and gas supplies need to be repaired and reconnected. Damage from hydrological disasters needs to be removed and infrastructure, houses and businesses repaired and rebuilt. Local governments often bear the brunt of the costs, but governments usually help, especially if the event is significant enough to be officially declared a disaster. If the disaster overwhelms the capacity of national resources, the country may request international assistance. Taxpayers ultimately finance disaster management activities. Individuals in wealthy countries who have insurance cover may recoup

Environmental and societal costs

Hydrological disasters can damage the natural environment especially when contaminants are released into the soil, air and water. Sewage often pollutes waterways during floods. Cleaning up this environmental damage adds significantly to the cost of disasters for governments.

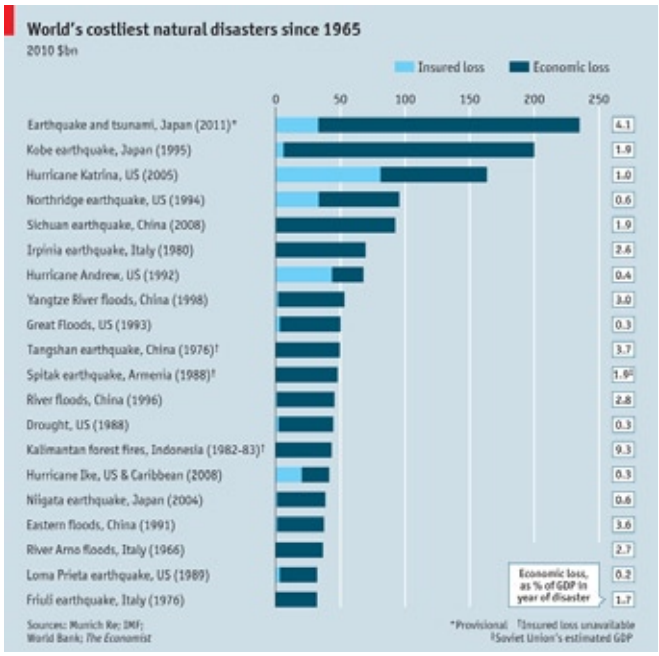
Hydrological disasters have a profound effect on communities. Social networks are disrupted as people are displaced and forced to relocate. School and home life is fractured and takes time to return to normal. The sense of community pride and spirit may also suffer. The effects on marginalised minorities such as those who are non-English speaking, elderly, homeless, disabled or on lower incomes is greater than on those who are better able to cope for themselves.

Are disasters more frequent?

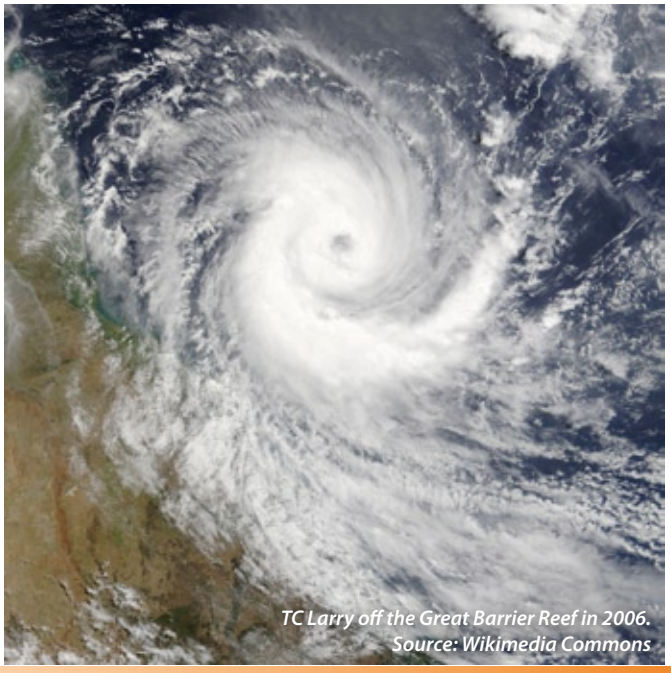
The number of hydrological events has increased. Scientists believe that this is linked with climate change, particularly the increases in extreme temperatures and rainfall. Global sea temperatures have risen over the past century and this contributed to an increase in hydrological disasters, even though some of these such as hurricanes may be cyclical in nature. However, there is now more international reporting of environmental disasters than previously because of increases in relief and reconstruction assistance. In addition, accurate modern technology for observing natural events has increased along with the number of specialised agencies that track and report hydrological disasters.

Australia's worst environmental disaster is the 'Black Saturday' bushfires of 7 February 2009 in which 173 people were killed and 2,298 homes destroyed.

World's costliest environmental disasters since 1965 in terms of insured loss and economic loss



Source: http://www.economist.com/blogs/dailychart/2011/03/natural_disasters



TC Larry off the Great Barrier Reef in 2006. Source: Wikimedia Commons

Reducing disaster risks

Risk is defined as the exposure of people to an environmental hazard. Risk can be reduced by undertaking an assessment to identify hazards and how people can best cope with them. Increasing people's awareness of risks as part of a public education campaign reduces the risk of negative consequences when environment hazards occur. Governments need to address the risks through laws and by providing structures and organisations to help communities plan for disasters. Emergency practice minimises loss of life in the event of a disaster, but is virtually impossible to organise in poorer countries. Reducing the risk of disaster also includes building large engineering solutions such as dams and levees. These are effective in diverting and reducing floods, especially in the heavily populated, extensive floodplains of eastern China.

Comprehensive early warning systems are essential to reduce the number of lives lost to hydrological hazards. For example, tropical cyclone Yasi that hit North Queensland in 2011 was the world's largest tropical storm, but despite the destruction to property and the environment, it claimed only one life because affected communities were well prepared. When the Indian Ocean tsunami of 2004 claimed more than 250 000 lives, there was no early warning system for the Indian Ocean. At that time, only the Pacific Ocean had such a system. Now there is an early warning system which has been used successfully to alert people to possible tsunamis.

Reducing vulnerability

Vulnerability refers not only to the ability of the community to cope with hazards, but also its ability to recover from them. The UN's Disaster Risk Reduction (DRR) strategy recognises that vulnerable groups such as the poor and socially excluded lack the capacity to cope with major hazards because of existing environmental, social, economic and political factors. For example, slum dwellers often build in unsafe areas prone to flooding or landslides. DRR aims to minimise vulnerabilities and disaster risks in a community by preventing or limiting (mitigating and preparing for) the negative impacts of hazards. The degree of vulnerability in a community varies according to several factors including socio-economic level (wealth), education and awareness of hazards, organisational structures such as emergency services and volunteer organisations, mass communication, and people's age and health. Land use planning can also minimise the impact of hazards. For example, cyclone standards are mandatory for all new buildings in northern Australia.

Source: Wikimedia Commons

Disaster management cycle

Source: http://www.docstoc.com/docs/28922343/Disaster-Risk-Management-Cycle#

OVERVIEW YEAR 8 – GEOMORPHIC OR BIOTIC HAZARDS

GEOWORLD (MACMILLAN)

Risks, vulnerability, management

About 500 million people live on or close to active volcanoes as they provide minerals, geothermal energy, fertile soils and tourism. These ***vulnerable*** people are at ***risk*** from exploding rocks and poisonous gasses. For example in 1902 on the island of Martinique the eruption of Mt Pelee destroyed the town of Saint Pierre.

The victims of the Indonesian tsunami in 2004 were unaware of the warning signs of an approaching tsunami (e.g. water line disappearing into the far ocean) which killed almost 310,000 people in 14 countries.

Obviously, little can be done to block these huge tsunami waves and volcanic explosions, however, governments are now more aware of the ***risk*** these ***hazards*** are to ***vulnerable*** people and have implemented plans to reduce their adverse impacts**.** As every $1 spent on preventative disaster results in an $8 reduction in damages from disasters the UN International Day for Disaster Reduction (IDDR) promotes disaster prevention and preparedness. Aimed to warn people of impeding hazards, Earth Observation (EO) technologies include thousands of data buoys in oceans, land-based monitoring stations and 60 environmental satellites orbiting Earth.

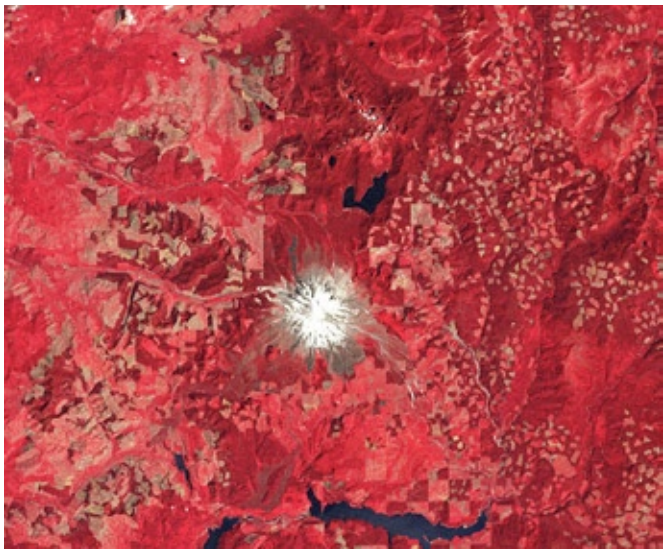
Deaths from natural disasters by death toll

Rank	Deaths	Event*
2	242,419–779,000	1976 Tangshan earthquake, China
4	316,000	2010 Haiti earthquake, Haiti
5	240,000	2004 Indian Ocean Tsunami, Indonesia
6	234,117	1920 Haiyuan earthquake, China
7	142,000	1923 Great Kanto earthquake, Japan
10	123,000	1908 Messina earthquake/tsunami, Italy

Adapted from http://en.wikipedia.org/wiki/List_of_natural_disasters_by_death_toll

Satellite imagery – Before and after the 1980 Mt St Helens eruption (USA)

a) Before the 1980 Mt St .Helens Eruption



b) Four months after the 1980 Mt St Helens Eruption

Source: http://www.businessinsider.com/satellite-images-natural-disasters-2011-3?op=1

Photo of the south face of Mt St Helens during the eruption of March 8, 2005
Source: Wikimedia Commons

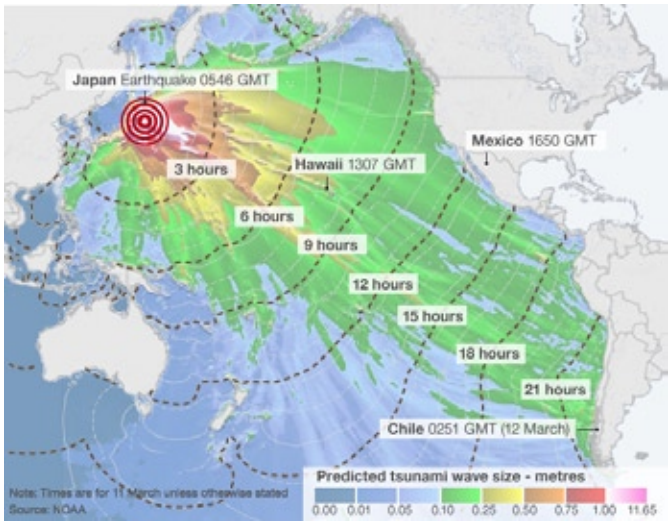
Satellite image of ash plume from volcanic explosion of Eyjafjallajökull in Iceland 2010

Source: http://tucsoncitizen.com/wryheat/2010/04/16/geologic-setting-of-icelandic-volcanoes/

Map locating the 2010 Haiti earthquake:

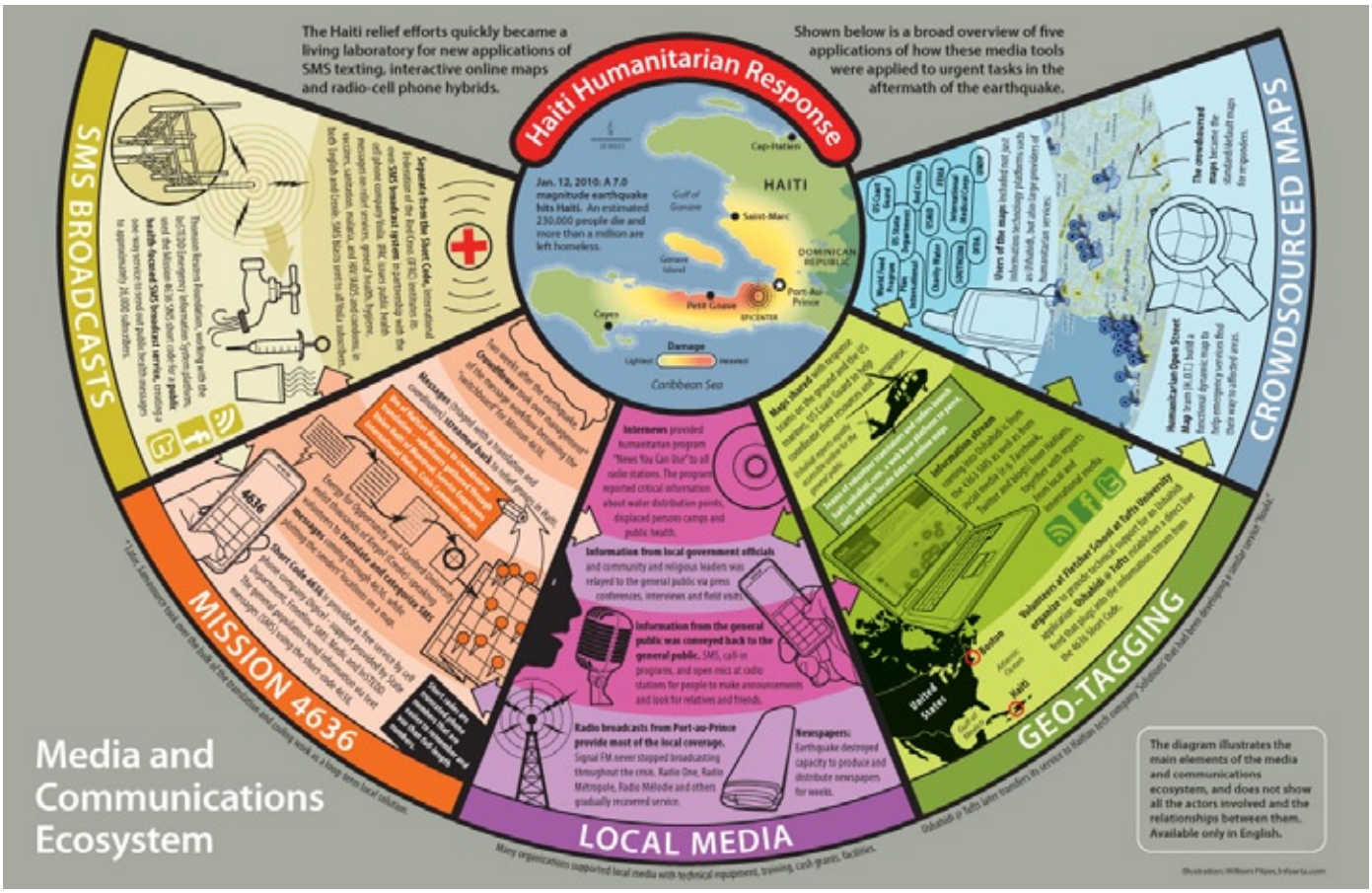
Source: http://news.bbc.co.uk/2/hi/8466385.stm

Map tsunami wave heights and times it reaches places 2011



Source: http://serc.carleton.edu/images/NAGTWorkshops/visualization/collections/2011_japan_earthquake_tsunami.jpg

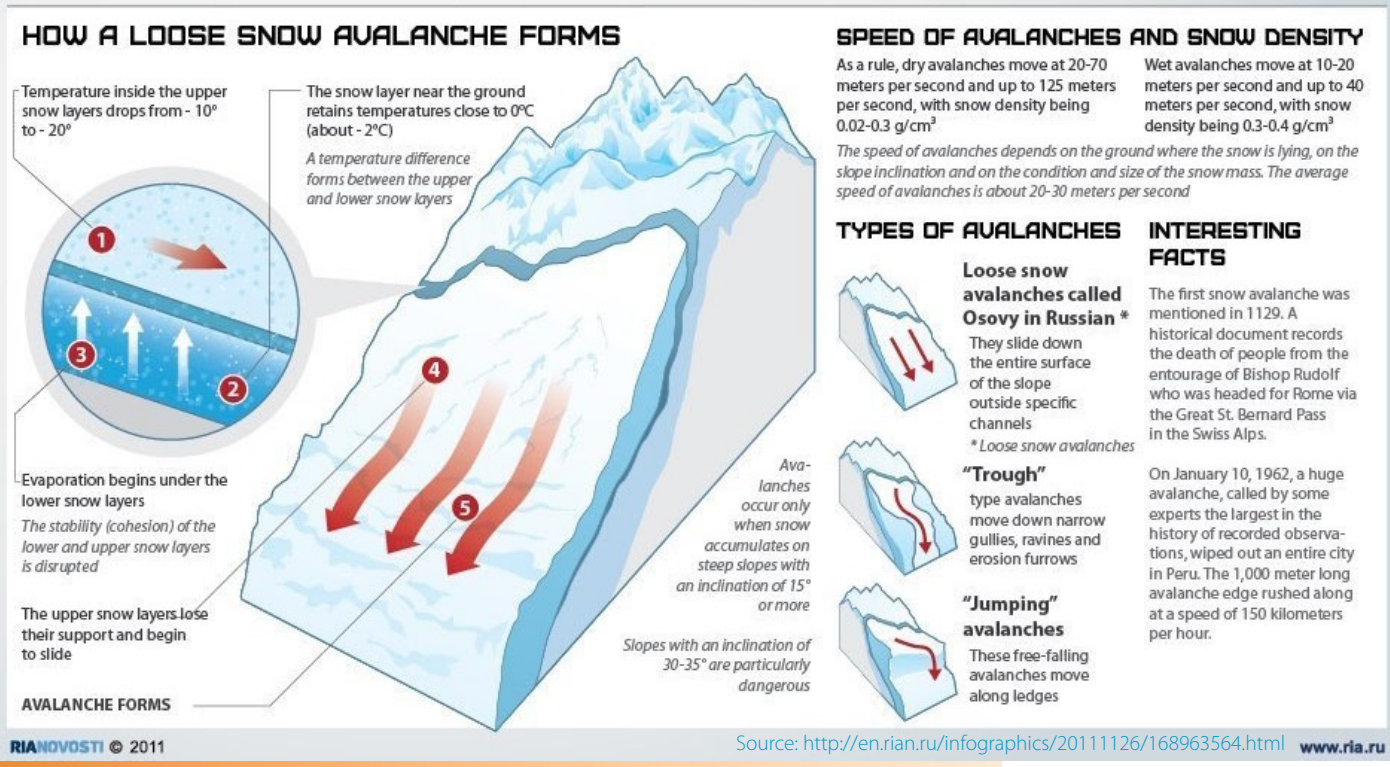
Haiti's humanitarian response



Source: http://cdn.theatlantic.com/static/mt/assets/science/haititech.jpg

Causes of avalanches

An avalanche is a mass of snow falling or sliding down from large mountain slopes. It resembles a landslide. As it moves, the avalanche creates a shock wave facilitating the greatest destruction



Source: http://en.rian.ru/infographics/20111126/168963564.html

Fire hazards

Rank	Death toll	Event	Date
1	1,200 – 2,500	Peshtigo, Wisconsin, USA	1871
2	1,200	Kursha-2, Soviet Union	1936
3	453	Cloquet Fire, Minnesota, USA	1918
4	418	Great Hinckley Fire, Minnesota, USA	1894
5	282	Thumb Fire, Michigan, USA	1881
6	273	Matheson Fire, Ontario, Canada	1916
7	240	Sumatra and Kalimantan, Indonesia	1997
8	230	Landes region. France	1949
9	213	Black Dragon, China	1987
10	173	Black Saturday, Australia	2009

Adapted from http://en.wikipedia.org/wiki/List_of_natural_disasters_by_death_tol

During the first week of June 2009, Sustainable Resource Alberta burned nearly 8,000 hectares of forest in Western Alberta. The forest was destroyed to bring about greater diversity, stem the spread of mountain pine beetle and to create a fire barrier for any future wild fires. Image source: http://commons.wikimedia.org/wiki/File:Aerial_view_of_a_forest_fire_in_Saskatchewan_-b.jpg