Weather

More

Unit 1
More about floods and thunderstorms

The weather can be particularly awful, if it rains heavily or heavy storms rip through the country.

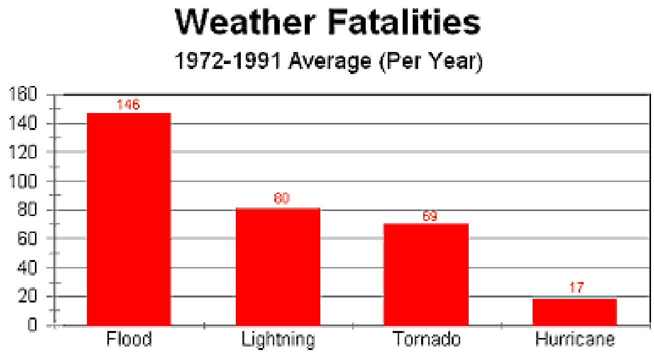
Heavy rainfall and floods cause enormous damage world-wide and cost more human lives than we might expect. Sudden rainfall, which changes small brooks into violent wide rivers, turned the Elbe and Moldowa rivers into big lakes in summer 2002. Wide areas in Eastern Germany, the Czech Republic and Poland were flooded. People were in danger and could not be warned in adequate time. Storm tides threaten the coasts and undercut the cliffs causing landslides. In this unit we look at several sorts of flooding, the damage they cause, and why they occur. We also explain how a thunderstorm is formed.

1. In case of thunderstorm and heavy showers we take refuge in cars or closed rooms. They offer not only a dry place but also protection from flashes.

Part 1: Flaschfloods

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. Around 90% of the damage caused by natural disasters (excluding droughts) is caused by floods and their associated flows of debris.

Most communities on Earth experience some kind of flooding event.



1. Flooding kills almost twice as many people each year in the USA as tornadoes and hurricanes put together.

source: http://www.erh.noaa.gov/er/cae/svrwx/flood.htm

Over the 10-year period from 1988 to 1997, floods cost the USA, on average, $3.7 billion annually. The long-term (1940 to 1999) average number of lives lost was 110 people each year and these deaths were mostly the result of flash floods.

On the 14th of June 1990 in Shadyside, Ohio, USA, 101.6 mm of rain fell in less than two hours. This produced a 9 m high wall of water. Twenty six people died and about $7 million worth of damages occurred.

Flash floods occur within six hours of a rain event or after a dam bursts or a river embankment fails. They can also occur when water is suddenly released from behind an ice or debris jam. Flash floods often catch people unaware. The best response to any signs of flash flooding is to move immediately and quickly to higher ground.

2. source: http://www.dd.org/~tale/minden-flood/page3/

Intense rainfall during storms creates small, fast moving streams of water. These streams of water can have enough power to wash away sections of pavement and parts of houses. The lack of water permeable ground in urban environments makes the situation worse. Urbanisation increases water runoff two to six times over what would occur on a natural terrain. During periods of urban flooding, streets can become swift moving rivers, while basements and underpasses can become death traps as they fill with water.

3. VENEZUELA - Mud flows and massive erosion on the Venezuelan north coast (December 1999).
source: http://earth.esa.int/applications/dm/GSP/venezuel.htm

4. Unexpected torrential rains fell in the north of Venezuela from the 12th to the 16th December 1999. These caused massive landslides and floods.

These unexpected rains caused serious environmental damage. The rains continued throughout January and February, producing further landslides and flooding.

Several factors contribute to flooding. The two key elements are rainfall intensity and duration. Intensity is the rate of rainfall, and duration is how long the rain lasts. Topography, soil conditions and ground cover also play important roles. Most flash flooding is caused by slow-moving thunderstorms, thunderstorms repeatedly moving over the same area, or heavy rains from hurricanes and tropical storms. Floods, on the other hand, can be slow- or fast-rising, but generally develop over a period of hours or days.

Flash floods can roll boulders, tear out trees, destroy buildings and bridges and scour out new channels. Rapidly rising water can reach heights of 30 feet or more. Furthermore, flash flood-producing rains can also trigger catastrophic mud slides.

Flash floods are very dangerous. Only 15 cm of fast-moving water can sweep a person off their feet and cars become buoyant in about 61 cm of water.

Part 2: Riverfloods

There are several different types of floods:

River flood

Flooding along rivers is a natural and inevitable part of life. Some floods occur seasonally when winter or spring rains, coupled with melting snows, fill river basins with too much water, too quickly. Torrential rains from decaying hurricanes or tropical systems can also produce river flooding.

1. Mississippi River Flood
source: http://www.umesc.usgs.gov/flood_2001/surface.html

Coastal flood

Winds generated from tropical storms and hurricanes or intense offshore low pressure systems can drive ocean water inland and cause significant flooding. Escape routes can be cut off and blocked by high water. Coastal flooding can also be produced by sea waves called tsunamis, sometimes referred to as tidal waves. These waves are produced by earthquakes or volcanic activity.

Urban flood

As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanisation increases water runoff 2 to 6 times over what would occur on natural terrain. During periods of urban flooding, streets can become swift moving rivers, while basements can become death traps as they fill with water.

2. Urban flood
source: www.crh.noaa.gov

Flash flood

Have a look at the page on flash floods in this section of the climate encyclopaedia.

Ice jam

Floating ice can accumulate at a natural or man-made obstructions and stop the flow of water. Once the obstruction is removed, large amounts of water can be released suddenly and this can cause flooding.

3. Ice jams on the Hudson River
source: http://www.erh.noaa.gov/er/aly/photos/photo.htm

The most common floods are the river floods.

Commercial forestry can also influence flooding risk. Deforestation causes higher surface water runoff. This in turn causes increased soil erosion and therefore reduced water storage capacity.

Landuse is an important factor governing the water levels in rivers and the frequency of high runoff events.

4. Dike bursting on the river Tisza (Hungary), 2001

Ploughing, road construction and soil compaction during forestry activity all cause short term modification in river flood behaviour. Most people believe that deforestation increases flooding risk and so tree planting is suggested as a remediation technique.

Every alteration in the pattern of agricultural production can be shown to modify flood occurrence and the ploughing up of former extensive grasslands is said to have increased the flood potential of some river basins. Removal of vegetation or conversion to plants with lower evapotranspiration and water capture capacity, increases run-off volumes and lowers water storage.

More intense rainfall events are predicted in the future. The Intergovermental Panel of Climate Change (IPCC) state that these rainfall events will increase the likelihood of landslides, avalanches and mudslides.

River	Year	Total Losses to Society (in U.S. millions)	Total Insured Losses (in U.S. millions)
Rhine	1993	$2,000	$800
Po	1994	$9,300	$300
Rhine	1995	$2,000	$780
Oder	1997	$5,275	$785

5. The summary of losses in Germany by Jonathan Conway

source: http://www.facworld.com/FacWorld.nsf/doc/euflood/$file/floodeu2.pdf

The 'Flood of the Century' was on the river Elbe in 2002. In parts of the Erzgebirge mountain range between Germany/Saxony and The Czech Republic more than 300 mm of rain fell in one day. The extreme precipitation was followed by a very quick rise in the water levels of the Elbe tributaries, in particular the rivers which drain the Erzgebirge to the north. The water in the Elbe reached levels which had not been recorded for centuries. The total economic damages resulting from the August flood (the Czech Republic: € 3 billion, Austria: € 3 billion; Germany: € 9.2 billion) represent a new European record for flood damages.

6. The flooding of the Elbe near Elster (left) and the flooded streets of Meissen (right), photos by M. Zebisch, TU Berlin.
source: http://www.uni-frankfurt.de/~jrapp/centuryflood.pdf

Part 3: Thunderstorms

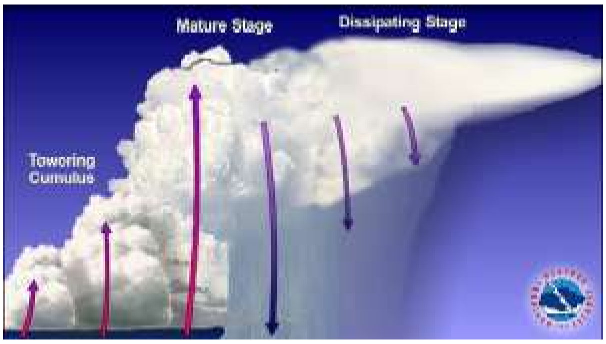
Types of thunderstorms

Single Cell Storms

Thunderstorms can consist of just one ordinary cell that transitions through its life cycle and dissipates without additional new cell formation. True single cell storms are, however, relatively rare since even the weakest of storms usually occurs as multicell updraft event. Single cell storms seem quite random (perhaps because of our lack of understanding) in their production of brief severe events such as hail, some heavy rainfall and occasional weak tornadoes.

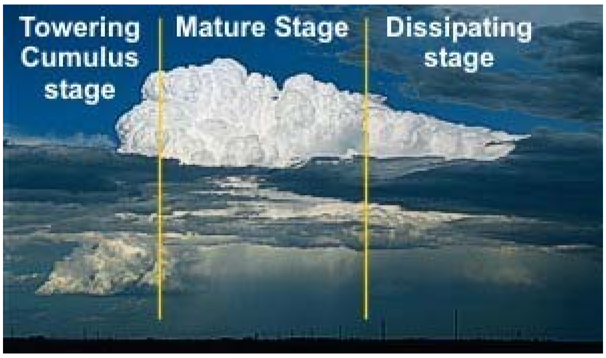
1. source: http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/svr/type/sngl/ovr.rxm

Multicell Storms



2. a)

Thunderstorms often form in clusters with a group of cells moving as a single unit, with each cell in a different stage of the thunderstorm life cycle. Generally these storms are more potent than single cell storms, but considerably less so than supercells.



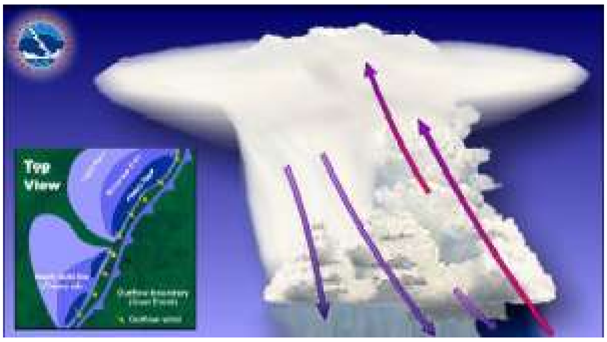
Unlike ordinary single cells, cluster storms can last for several hours producing large hail, damaging winds, flash flooding, and isolated tornados.

2. b) source: www.srh.weather.gov

Multicell Lines (Squall Lines)

Sometimes thunderstorms will form in a line which can extend laterally for hundreds of miles. These "squall lines" can persist for many hours and produce damaging winds and hail. A squall line is a line of thunderstorms that have a common lifting mechanism. Lifting mechanisms tend to occur in bands. The rain cooled air or "gust front" spreading out from underneath the squall line acts as a mini cold front, continually lifting warm moist air to fuel the storms. Examples of banded lifting mechanisms include fronts, large outflow boundaries, gravity waves, etc.

The classic squall line will develop out ahead of and parallel to a cold front or dry line boundary. The storms first develop where there is the best combination of moisture, instability and lift. The storms will continue to evolve and new cells will develop (commonly toward the south and east).



3. a)

The squall line will sustain itself by producing its own lift due to outflow boundaries. As long as instability and moisture remain present out ahead of the squall line, the squall line will continue to propagate. Often along the leading edge of the line a low hanging arc of cloudiness will form called the shelf cloud. Gusty, sometimes damaging outflow winds will spread out horizontally along the ground behind the shelf cloud.

3. b) Schematic of a squall line (top) and accompanying photograph (below).source: www.srh.weather.gov

Downburst winds are the main threat, although hail as large as golf balls and gustnadoes can occur. Flash floods occasionally occur when the squall line decelerates or even becomes stationary, with thunderstorms moving parallel to the line and repeatedly across the same area.

Supercell Thunderstorms

Supercell thunderstorms are a special kind of single cell thunderstorm that can persist for many hours. They are responsible for nearly all of the significant tornados produced in the U.S. and for most of the hailstones larger than golf ball size. Supercells are also known to produce extreme winds and flash flooding.

4. a) source: www.srh.weather.gov

4. b) source: www.srh.weather.gov

They are characterized by a rotating updraft (usually cyclonic) which results from a storm growing in an environment of significant vertical wind shear. Wind shear occurs when the winds are changing direction and increasing with height.

The most ideal conditions for supercells occurs when the winds are veering or turning clockwise with height. For example, in a veering wind situation the winds may be from the south at the surface and from the west at 15,000 feet. Beneath the supercell, the rotation of the storm is often visible as well.