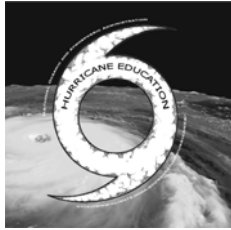


STORM SURGE



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A hurricane is a powerful, spiraling storm that begins over a warm sea, near the equator. When a hurricane hits land, it can do great damage through its **storm surge**, fierce winds, torrential rains, inland flooding, and huge waves crashing ashore.



NOAA aerial image for larger view of New Orleans, La., where homes were nearly swallowed up by flood waters.

Storm surge is one of the deadliest hazards in a hurricane, 9 out of 10 victims usually perish from storm surge., " National Weather Service Meteorologist John Metz.



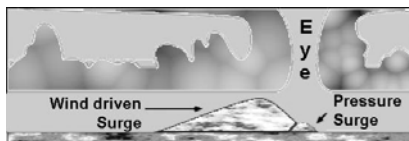
Storm surge warning sign

AIR Worldwide estimates that Katrina property damage caused by water will total approximately \$44 billion



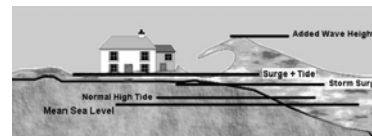
Eroded foundation and resulting collapse of a building on the coast following a hurricane-induced storm surge

Storm Surge



- is water that is pushed toward the shore by the force of the winds swirling around the storm
- sweep across the coast near the area where the eye of the hurricane makes landfall.
- accompany intense storms such as tropical cyclones

Storm Surge is a



- rise above the normal water level along the shore
- massive dome of water often 50 miles wide

[Storm Surge video](#) University of Illinois- Urbana Campus, Department of Atmospheric Sciences

Storm Surge can be influenced by

- **tides**- storm surge is added to the height of the tide, the surge will be greater if the storm crosses the coast on a high tide
- **speed of a storm**- the faster the storm moves across the coast, the quicker the surge builds
- **angle storm crosses coast**- the more head on, the higher the surge
- **winds**- as the winds increase, the water is piled higher and the waves on top of the surge are taller
- **shape of coastline**- bays and inlets can funnel and amplify surge, shallow coastlines will allow the surge to travel far inland

This advancing surge of water combines with the normal tides to create the hurricane **storm surge**, which increases the mean water level, putting the tide line higher on the coast and flooding areas that are normally beyond the reach of the ocean. The storm surge acts like a *bulldozer* sweeping away everything in its path and flooding low lying areas. The stronger the hurricane the larger the storm surge will be.

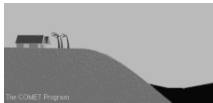


A section of shoreline before storm surge at Folly Beach, SC



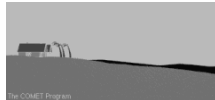
A section of shoreline after storm surge at Folly Beach, SC

The inland reach or inundation caused by a **storm surge** is influenced by the slope of the continental shelf and shoreline elevation.



A shallow sloping coastline will allow the storm surge to inundate coastal communities.

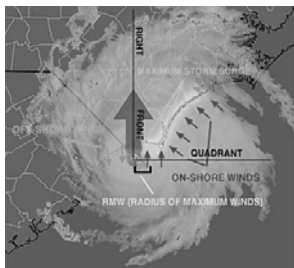
Communities developed on a steeper coastline will not see as much surge inundation, although large breaking waves can still present major problem



Storm Surge on a coastline can be impacted by

- **barrier islands**- deflects the wave back to the ocean
- **fringing reefs**- deflects the wave back to the ocean
- **levees**- deflects the wave back to the ocean
- **marshes**- absorb the impact of the surge
- **wetlands**- absorb the impact of the surge

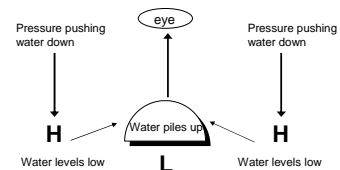
Storm Surge is caused by



onshore winds- strong winds blowing towards the shore help push water towards shore on the right front quadrant of the hurricane. This piling up contributes to most of the coastal flooding.

Storm Surge is caused by

reduced atmospheric pressure- the air pressure in the eye of the storm is much lower than its surroundings, higher pressure outside of the eye, pushes water down in the surrounding ocean, pushing water up in the eye



Storm Surge prediction is tricky

Having a way to simulate hurricane **storm surge** and flooding is especially useful because hurricanes are relatively infrequent and individual events. A storm's strength is only one factor in flooding. Water heights change quickly depending on wind, the storm's track and the obstacles encountered. So there isn't a good historical record that would allow scientists to judge how often a place might be flooded or how the next big storm might affect a given locale.

SO.....

The SLOSH Model was developed

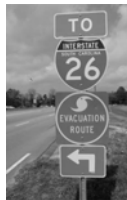
SLOSH (Sea, Lake and Overland Surges from Hurricanes) is a computerized model run by the National Hurricane Center (NHC) to estimate storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes by taking into account:



- Pressure
- Size
- Forward speed
- Track
- Winds

Graphical output from the model displays color-coded storm surge heights for a particular area.

Storm Surge calculations are applied to a specific locale's shoreline, incorporating the slope of the coastline, unique bay and river configurations, water depths, bridges, roads, and other physical features. Emergency managers use the data from SLOSH to determine which areas must be evacuated to avoid the potentially deadly impacts of storm surge associated with a hurricane.



Evacuation route sign

Storm Surge can cause damage through

- the extended pounding of frequent waves, demolishing any structure not specifically designed to withstand such forces.
- the currents created by the surge combined with the action of the waves, severely eroding beaches and coastal highways compromising building foundations

Storm Surge Safety

- Select the nearest possible evacuation destination, preferably within your local area, and map out your route. Do not get on the road without a planned route or a place to go.
- Minimize the distance you must travel to reach a safe location; the farther you have to drive, the higher the likelihood of encountering traffic congestion and other problems on the roadways.
- Choose the home of the closest friend or relative outside a designated evacuation zone and discuss your plan with them before hurricane season.
- You may also choose a hotel/motel outside of the vulnerable area.
- If neither of these options is available, consider the closest possible public shelter, preferably within your local area.



Storm Surge Safety

- Use the evacuation routes designated by authorities and, if possible, become familiar with your route by driving it before an evacuation order is issued.
- Contact your local emergency management office to register or get information regarding anyone in your household whom may require special assistance in order to evacuate.
- Prepare a separate pet plan, most public shelters do not accept pets.
- Prepare your home prior to leaving by boarding up doors and windows, securing or moving indoors all yard objects, and turning off all utilities.
- Before leaving, fill your car with gas and withdraw extra money from the ATM.
- Take all prescription medicines and special medical items, such as glasses and diapers.



Storm Surge Safety

- If you live in an evacuation zone and are ordered to evacuate by state or local officials, do so as quickly as possible. Do not wait or delay your departure, to do so will only increase your chances of being stuck in traffic, or even worse, not being able to get out at all.
- Expect traffic congestion and delays during evacuations.
- Expect and plan for significantly longer travel times than normal to reach your family's intended destination.
- Stay tuned to a local radio or television station and listen carefully for any advisories or specific instructions from local officials.
- Monitor your NOAA weather radio.



References

- NOAA Storm Surge information http://www.nhc.noaa.gov/HAW2/english/storm_surge.shtml#actions
- NOAA Storm Surge Safety http://www.nhc.noaa.gov/HAW2/english/storm_surge.shtml#actions
- NOAA Coastal Services Center FAQ— provides frequently asked questions about and answers to hurricane evacuation studies, evacuation zone data, storm surge data, and shelters. http://www.csc.noaa.gov/hez_tool/faq.html
- SLOSH model <http://www.nhc.noaa.gov/HAW2/english/surge/slosh.shtml>
- Hurricane strength- http://www.nhc.noaa.gov/HAW2/english/high_winds.shtml
- *Surge of the Storm*— hands on activity in which students use water, sand, and blocks of wood to model the affects of storm surge on a coastline. <http://seacoos.org/Community%20and%20Classroom/hurricane-classroom/surge-online>
- Max Mayfield, director of the National Hurricane Center, discusses storm surge http://www.nhc.noaa.gov/HAW2/pdf/storm_surge.mp3
- NOAA Hurricane teaching resources and related links http://www.climate.noaa.gov/index.jsp?pg=/education/hurricanes/resource_s.jsp