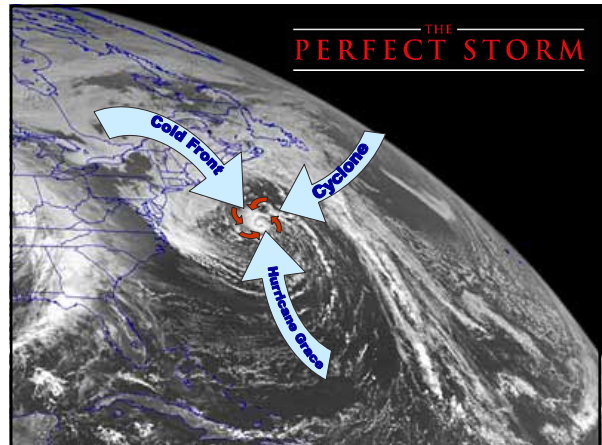




Geology

- ▲ *Hurricanes: violent warm core tropical storm and min wind speed of 74 mph. Rotates counterclockwise spiraling around region of low pressure (eye/center)*
- ▲ June 1- November 30
- ▲ Saffir-Simpson Hurricane Scale (1-5)
- ▲ 4 Stages of Hurricane Growth: Tropical Disturbance, Tropical Depression, Tropical Storm, Hurricane

- ▲ *Nor'easter: east moving cold air meets warm air from Eastern Atlantic Coast region*
 - ▲ snow, rain, freezing rain, and sleet
 - ▲ strong winds
 - ▲ significant coastal flooding
 - ▲ blizzard conditions
- ▲ *Hybrid Storm: special type of coastal storm that can produce major problems in the fall; combined char. Of tropical & extratropical/midlatitude storms*



Precursors

- ▲ *Hurricane Bob, August 1991*
- ▲ *Hurricane Grace, October 28, 1991*
- ▲ *Strong Extratropical Storm*
 - ▲ Area of Low Pressure

Perfect Storm Event
NOAA
GOES-7 Satellite
October 28, 1991
1901 UTC (1101 EST)

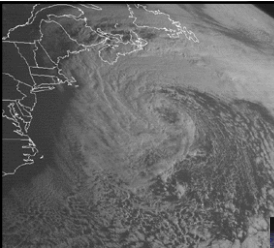
October 28, 1991

- ▲ *Subtropical storm E. Caribbean reaches hurricane status (Hurricane Grace)*
- ▲ *Extratropical storm off of New England*

Perfect Storm Event
NOAA
GOES-7 Satellite
October 29, 1991
1901 UTC (1101 EST)

October 29, 1991

- ▲ *Hurricane Grace changed direction (ENE)*
- ▲ *Extratropical storm absorbed Hurricane Grace*



October 30, 1991

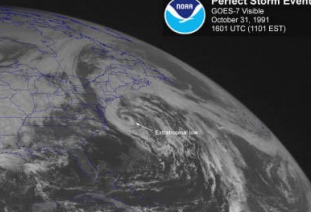
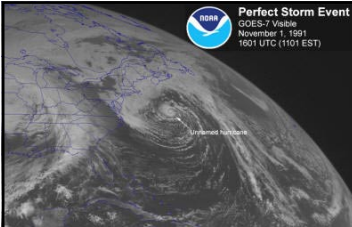
- ▲ Peak winds (~ 100 mph)
- ▲ 100 ft. waves (one of highest ever recorded)
- ▲ 10-30 ft. waves hitting coast

▲ Extratropical Storm turned SW → S

▲ Over Warm Gulf Stream

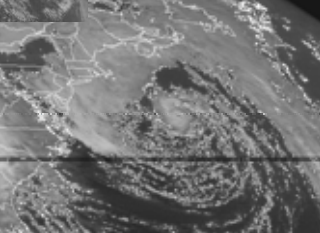
▲ hit New England Coast

October 31, 1991

Perfect Storm Event
GOES-7 Visible
November 1, 1991
1601 UTC (1101 EST)

November 1, 1991 (4 pm)

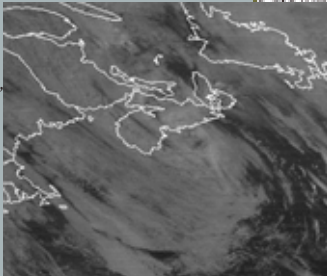
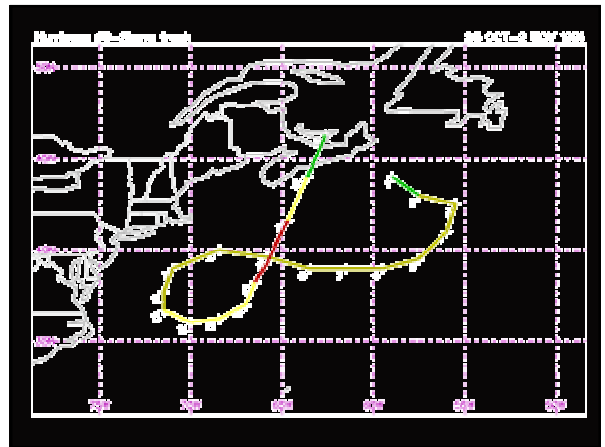


November 1, 1991 (6 pm)

- ▲ Tropical Storm intensity
- ▲ Late, eye forming (almost hurricane status)


▲ November 2:

- ▲ Makes counterclockwise loop
- ▲ Winds ~ 100 mph
- ▲ Hurricane Status
- ▲ Cyclone weakened
- ▲ Landfall near Halifax, Nova Scotia
- ▲ Dissipated 10 hours later



Preparation & Awareness

- ▲ New England storms commonly from West
 - ▲ Perfect storm came from East
- ▲ NWS, local meteorologists and Hurricane Ctr. Tracked storm
- ▲ Warnings and evacuations set out ahead of time (maritime warnings 36 hrs prior)
- ▲ Emergency Crews arrived early



After Effects

- ▲ Storm not thought of as real threat to land but more to ships
- ▲ Beach Erosion (10's m's removed from Hog Island, VA)
- ▲ Coastal Flooding (<100 miles inland)



Property Damage

- ▲ damage to lighthouses, lobster traps
- ▲ Homes disappeared or swept from foundations
- ▲ Seawalls, boardwalks, bulkheads and piers damaged
- ▲ A lot of small boats sunk
- ▲ Sand blown into streets



Main Causes of Death

- ▲ *Andrea Gail*
 - ▲ 6 deaths
 - ▲ Ignored warnings
- ▲ 2 drowned-capsized boat (NYC)
- ▲ Man either blown/swept off bridge (NY)
- ▲ Fisherman swept off rocks by heavy surf (RI)
- ▲ Man swept off rocks (Puerto Rico)
- ▲ Crewman from Nat'l Guard Helicopter



Comparison to other Events

- ▲ *Hurricane Andrew*
 - ▲ 165-180 mph winds
 - ▲ \$26 bil
 - ▲ 41 deaths
- ▲ *Hurricane Bob, August 1991*
 - ▲ \$2.8 bil
 - ▲ 18 deaths
 - ▲ Max winds=115 mph
- ▲ *The Perfect Storm*
 - ▲ \$1.3-2.6 bil
 - ▲ 11 deaths
 - ▲ Max winds=75mph-100mph
 - ▲ 5 days
- ▲ *Hurricane Ophelia, Sept. 2005*
 - ▲ Max winds= 85 mph
 - ▲ \$800 mil
 - ▲ 3 deaths

What was provided to disaster areas?

- ▲ Places with declared Federal Disasters:
 - ▲ Grants
 - ▲ Loans
 - ▲ IRS loss deductions on tax returns

What could they have done differently?

- ▲ Educate Northeast Coastline on Hybrid Hurricanes
- ▲ called it a hurricane
- ▲ Since:
 - ▲ Updated warning systems
 - ▲ Invested in education of these storm types
 - ▲ Improvements in forecasting (predict & track with greater accuracy)

Questions?



References

- ▲ <http://archives.cnn.com/2000/NATURE/06/30/perfect.storm/01>
- ▲ <http://archives.cnn.com/2000/NATURE/06/30/perfect.storm/02>
- ▲ http://www.fcnerf.org/coastal_training/toolkit/severe/case-study.html
- ▲ <http://www.mcquinesonline.com/andrew/storms/1991/1991%20Perfect%20Storm/track.htm>
- ▲ <http://www.perfectstorm.org/storms.cfm>
- ▲ http://www.us.ec.gc.ca/weather/hurricane/storm91.html#unnamed_Storms_of_1991-Canada
- ▲ <http://www.vcrlter.virginia.edu/gopher/Publications/TCRAdmin/1994Proposal/projdesc.txt>
- ▲ www.weather.com
- ▲ Epstein, David. "The Perfect Storm: The Storm." <http://perfectstorm.warnerbros.com/cmp/flash-thestorm-fr.html>
- ▲ Henson, Robert. "Hurricanes in Disguise." *Weatherwise*. Dec/Jan 96. Vol. 48, Issue 6.
- ▲ Morton, Robert A. "An Overview of Coastal Land Losses: With Emphasis on Southeastern US—Winter Storms (Extratropical Cyclones)." USGS. Open file Report 03-337.
- ▲ "The Perfect Storm—October 1991." NCDC. <<http://hvf.ncdc.noaa.gov/oa/satellite/satelliteseye/cyclones/pfctstorm91/pfctstorm.html>>
- ▲ "Storm Data & Unusual Weather Phenomena with Late Reports & Corrections: Unnamed Hurricane." NOAA. Oct. 1991. V. 33, No. 10.

