

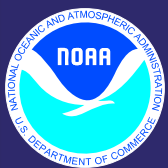
# Major Delaware River Flood June 2006



Presented by

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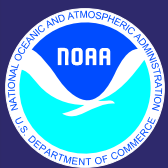


# Mission statement

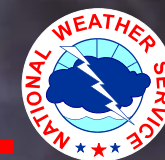
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- “The **National Weather Service (NWS)** provides weather, **hydrologic**, and climate **forecasts and warnings** for the United States, its territories, adjacent waters and ocean areas, **for the protection of life and property** and the enhancement of the national economy. NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community.”

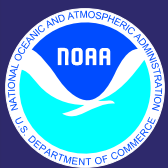


# Delaware River Basin



- Background:
- Longest un-dammed river east of the Mississippi
- Main stem 330 miles in length
- Drainage area - 13,539 square miles
- Includes PA, NY, NJ, and DE
- Provide 5% of the nations drinking water
- Provide NYC with 50% of it's drinking water
- Accessible within a short drive to 20% of the people living in the U.S.
- Designated a Wild and Scenic River – We Like the scenic part but are getting a little tired of the Wild part

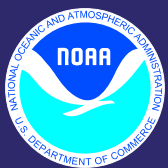




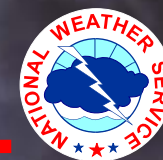
# 100 Year Flood (from USGS)



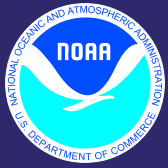
- **Why Don't These Floods Happen Every 100 Years?**
- **The term "100-year flood" is misleading because it leads people to believe that it happens only once every 100 years. The truth is that an uncommonly big flood can happen any year. **There is a 1-in-100 chance that a flood this size will happen any year.****



# 100 Year Flood



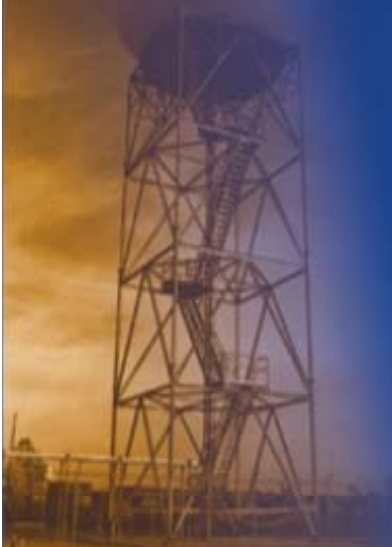
- **What Does It Take To Get One?**
- **Usually preceded by a wet period that “sets the stage” or an above normal snowpack.**
- **Often preceded a few days before by a “precursor flood event” that results in very wet soils and above normal river levels.**
- **Requires unusually heavy rain covering most of the river basin.**



# Flood 2006 – What Happened



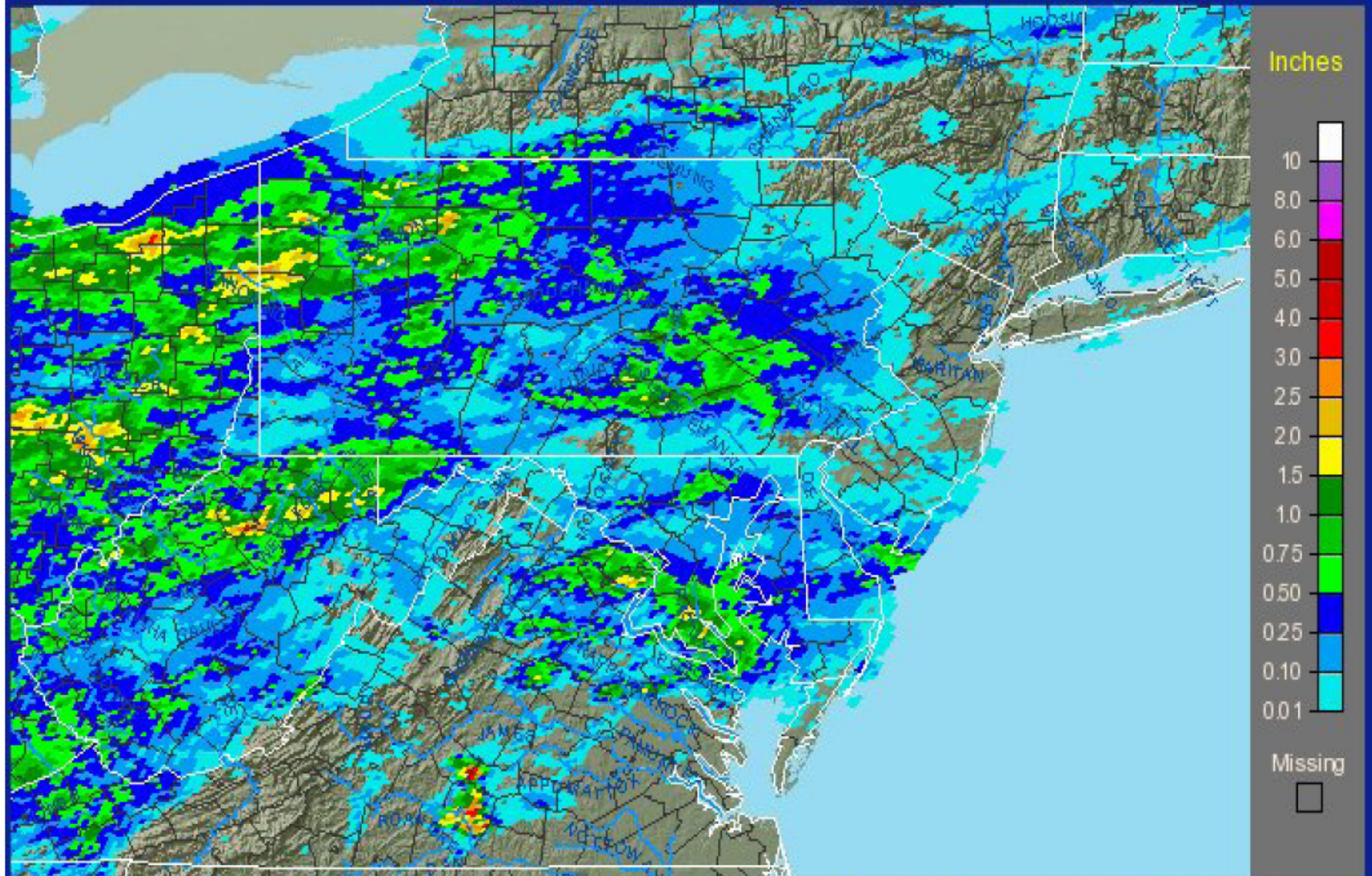
- **A tropical air mass set up over the mid-Atlantic Region around June 22<sup>nd</sup> and continued until the end of the month**
- **Impact – frequent heavy rainfall over portions of the basin – culminating in a major rain event June 27<sup>th</sup>-28<sup>th</sup>**



# 8 am Thursday 6/22 – 8 am Friday 6/23

Middle Atlantic RFC State College, PA  
1-Day Observed Precipitation - Valid 6/23/2006 1200 UTC

*Click on the image to zoom in*  
*Click on "States" to zoom out*

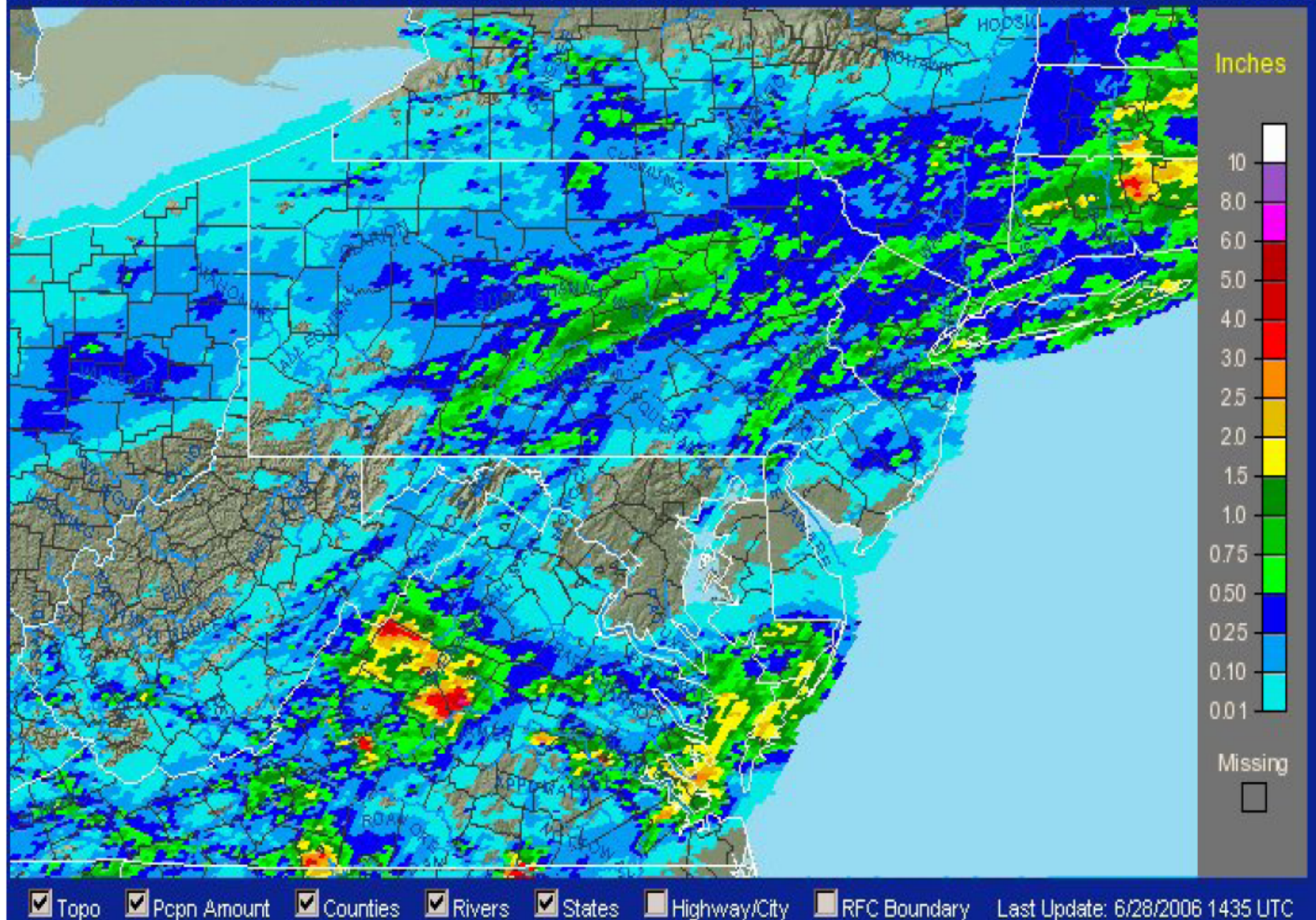


Topo  Pcpn Amount  Counties  Rivers  States  Highway/City  RFC Boundary Last Update: 6/28/2006 1435 UTC

# 8 am Friday 6/23 – 8 am Saturday 6/24

Middle Atlantic RFC State College, PA  
1-Day Observed Precipitation - Valid 6/24/2006 1200 UTC

*Click on the image to zoom in*  
*Click on "States" to zoom out*





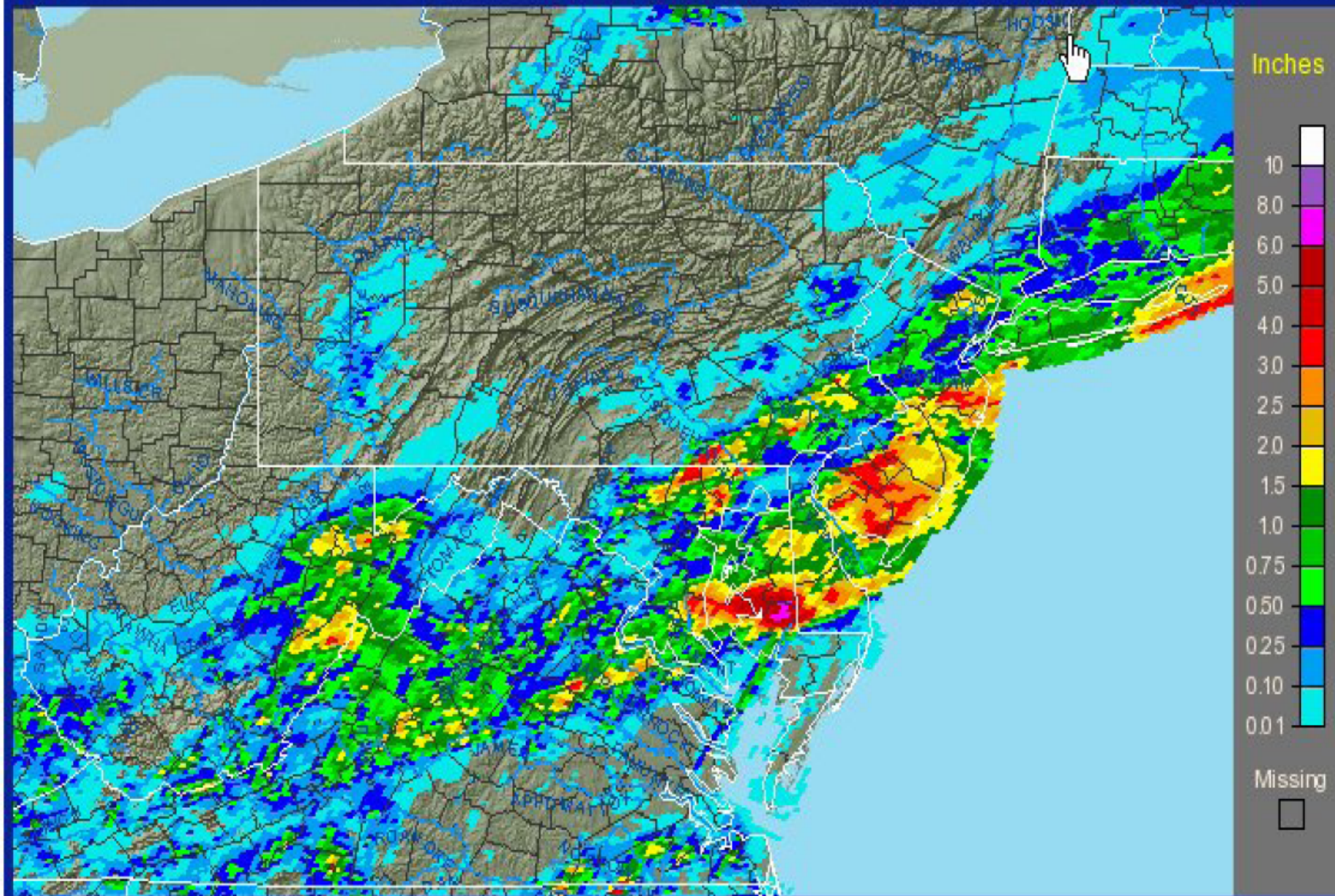
8 am Saturday 6/24 – 8 am Sunday 6/25

Middle Atlantic RFC State College, PA

1-Day Observed Precipitation - Valid 6/25/2006 1200 UTC

*Click on the image to zoom in*

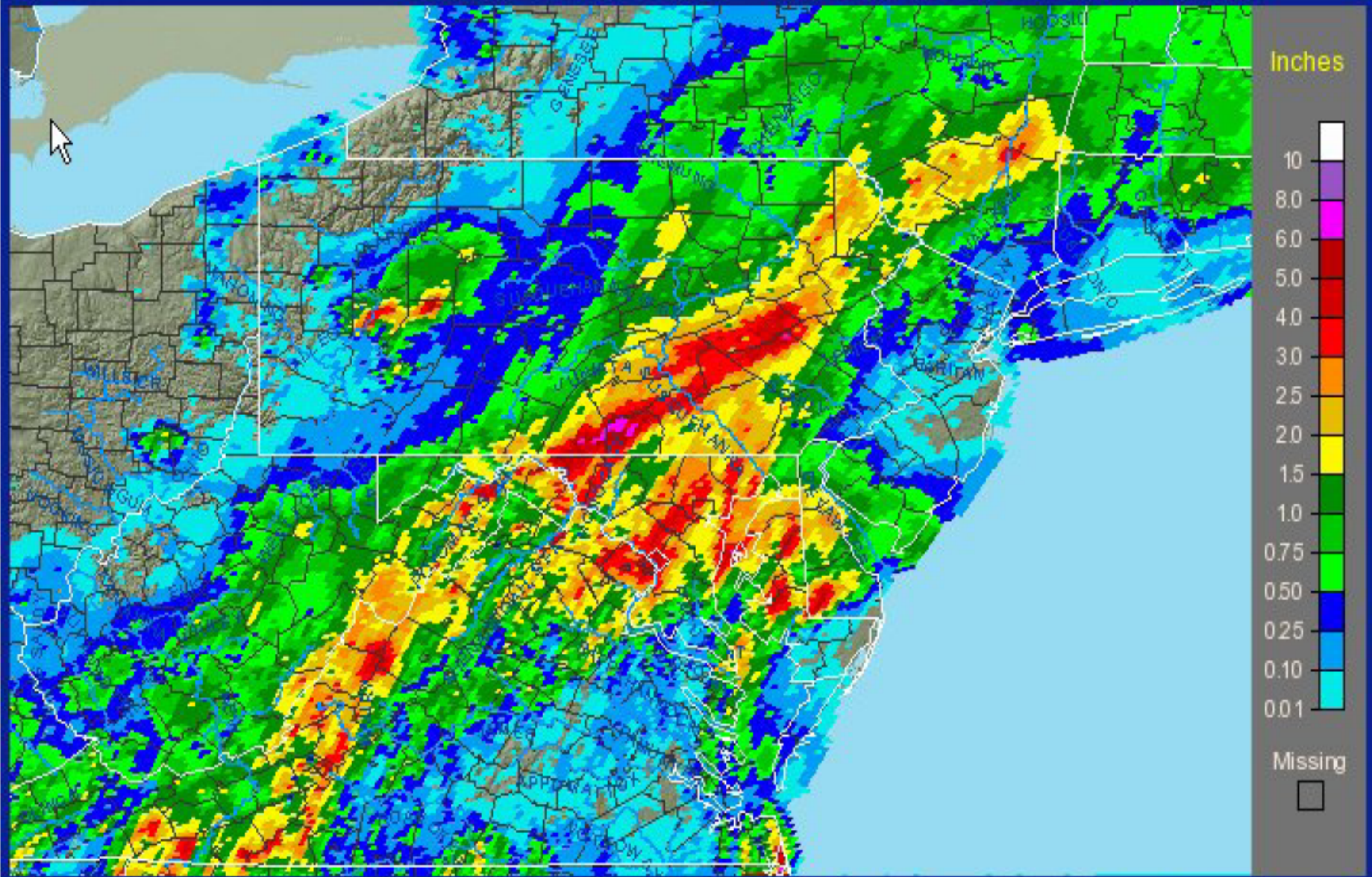
*Click on "States" to zoom out*



# 8 am Sunday 6/25 – 8 am Monday 6/26

Middle Atlantic RFC State College, PA  
1-Day Observed Precipitation - Valid 6/26/2006 1200 UTC

*Click on the image to zoom in*  
*Click on "States" to zoom out*

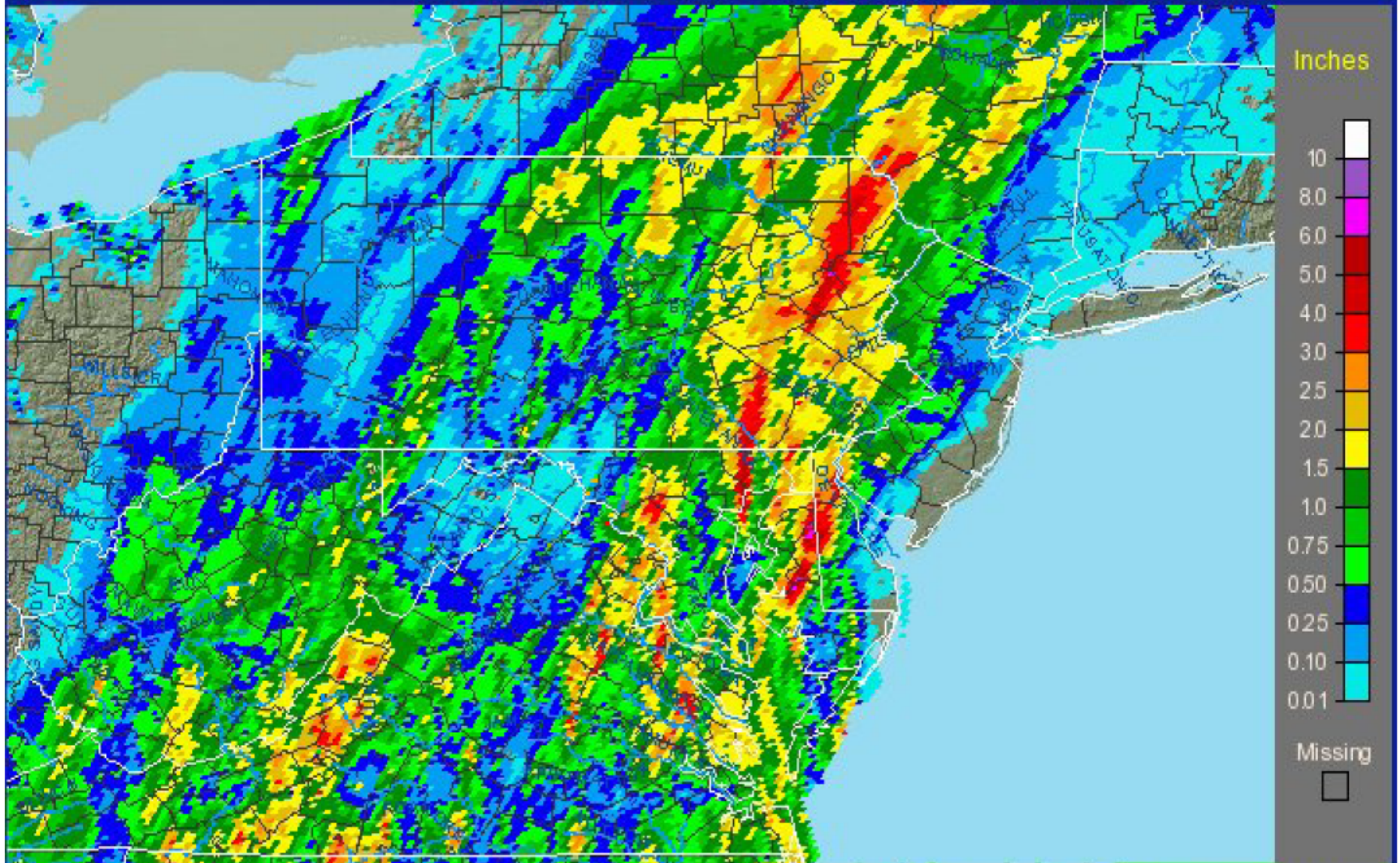


Topo  Pcpn Amount  Counties  Rivers  States  Highway/City  RFC Boundary Last Update: 6/28/2006 1435 UTC

# 8 am Monday 6/26 – 8 am Tuesday 6/27

Middle Atlantic RFC State College, PA  
1-Day Observed Precipitation - Valid 6/27/2006 1200 UTC

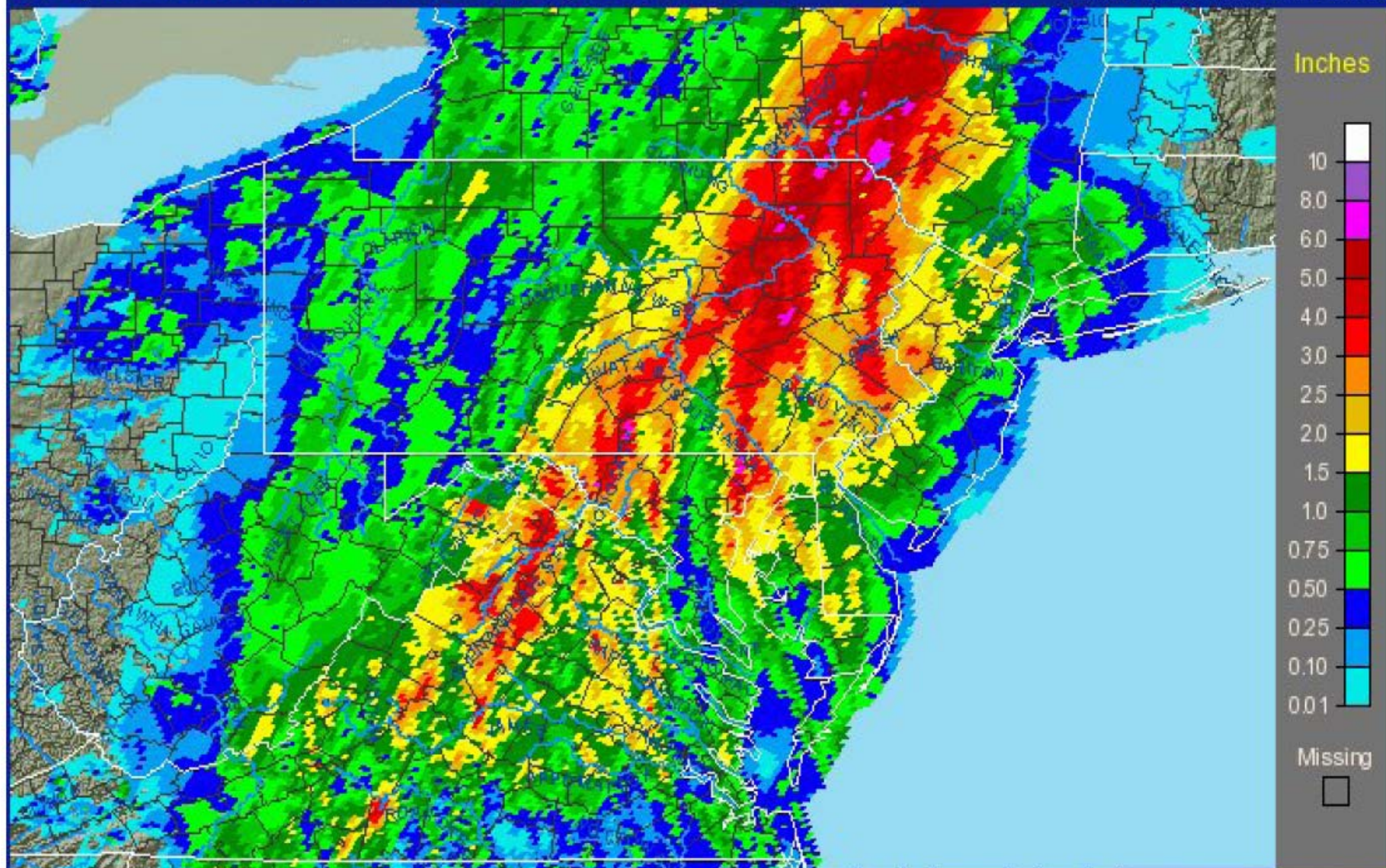
*Click on the image to zoom in*  
*Click on "States" to zoom out*



8 am (EDT) Tuesday 6/27 – 8 am Wednesday 6/28

Middle Atlantic RFC State College, PA  
1-Day Observed Precipitation - Valid 6/28/2006 1200 UTC

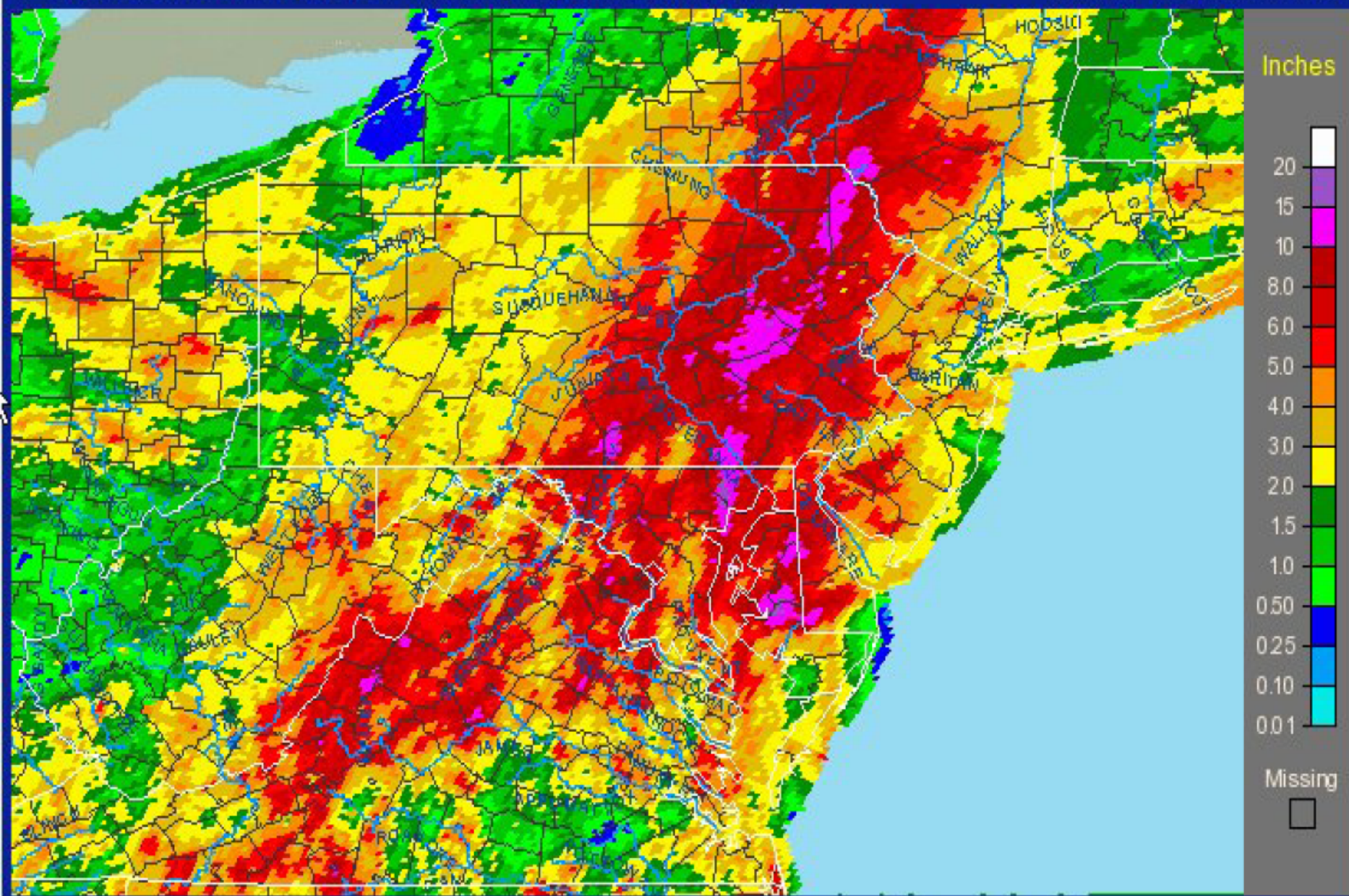
Click on the image to zoom in  
Click on "States" to zoom out

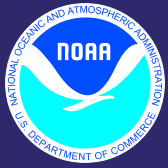


Topo  Pcpn Amount  Counties  Rivers  States  Highway/City  RFC Boundary Last Update: 6/28/2006 1435 UTC

Middle Atlantic RFC State College, PA  
7-Day Observed Precipitation - Valid 6/28/2006 1200 UTC

*Click on the image to zoom in*  
*Click on "States" to zoom out*

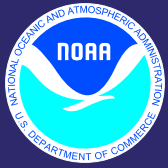




# Flooding – What was the Cause



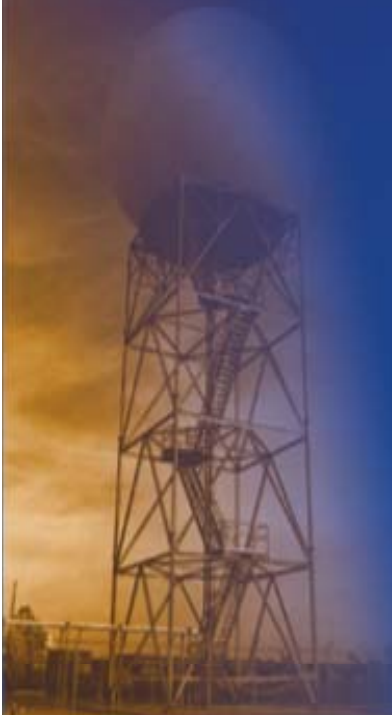
- **Excessive rainfall**
- **Those location which received 8 inches of rain in seven days experienced a 20 year event**
- **Those locations which received 10 inches of rain in seven days experienced a 100 year event**

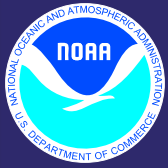


# Flooding – Rumors of the Cause



- **Reservoirs**
- **Upstream development**
- **Global Warming**





# Rumor - Reservoirs caused flooding

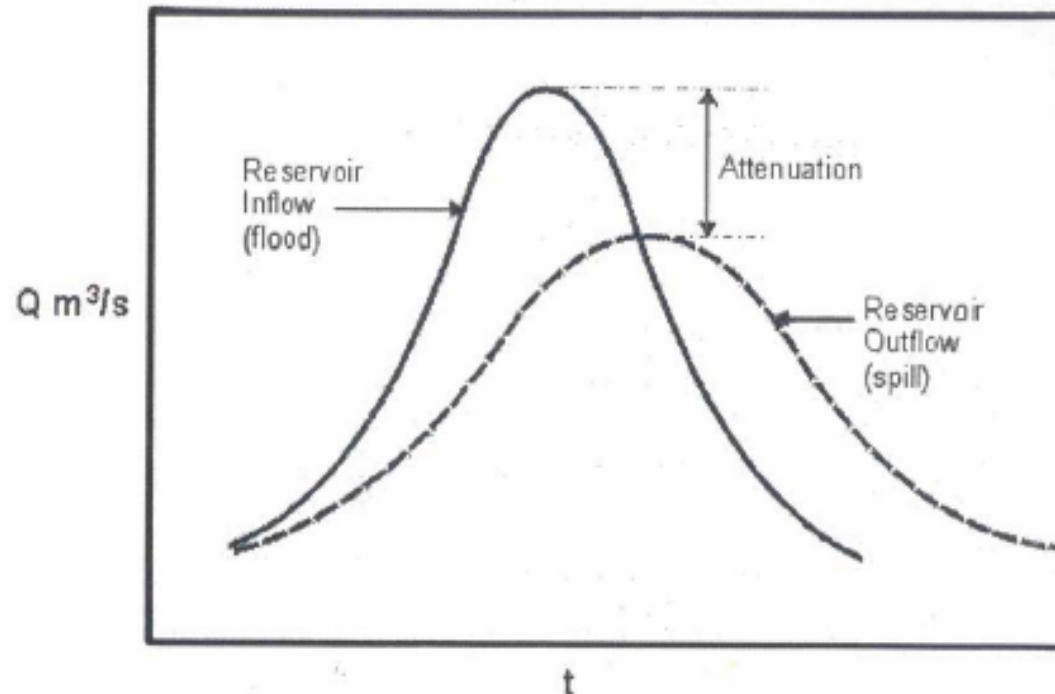
- **FACT:** Because of the heavy rainfall and previously wet conditions, many reservoirs were full (or nearly so) and ‘spilled’ water during this event.
- Even though they spilled water, they likely helped lessen the effects of the flooding
  - *How can this be true?*



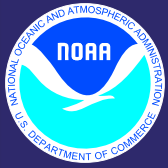


# Reservoir Attenuation

- Reservoirs provide attenuation even when full.



From "A Review of the Role of Dams in Flood Mitigation", a paper submitted to the World Commission on Dams ([www.dams.org](http://www.dams.org)) in March 2000 by Peter Hawker

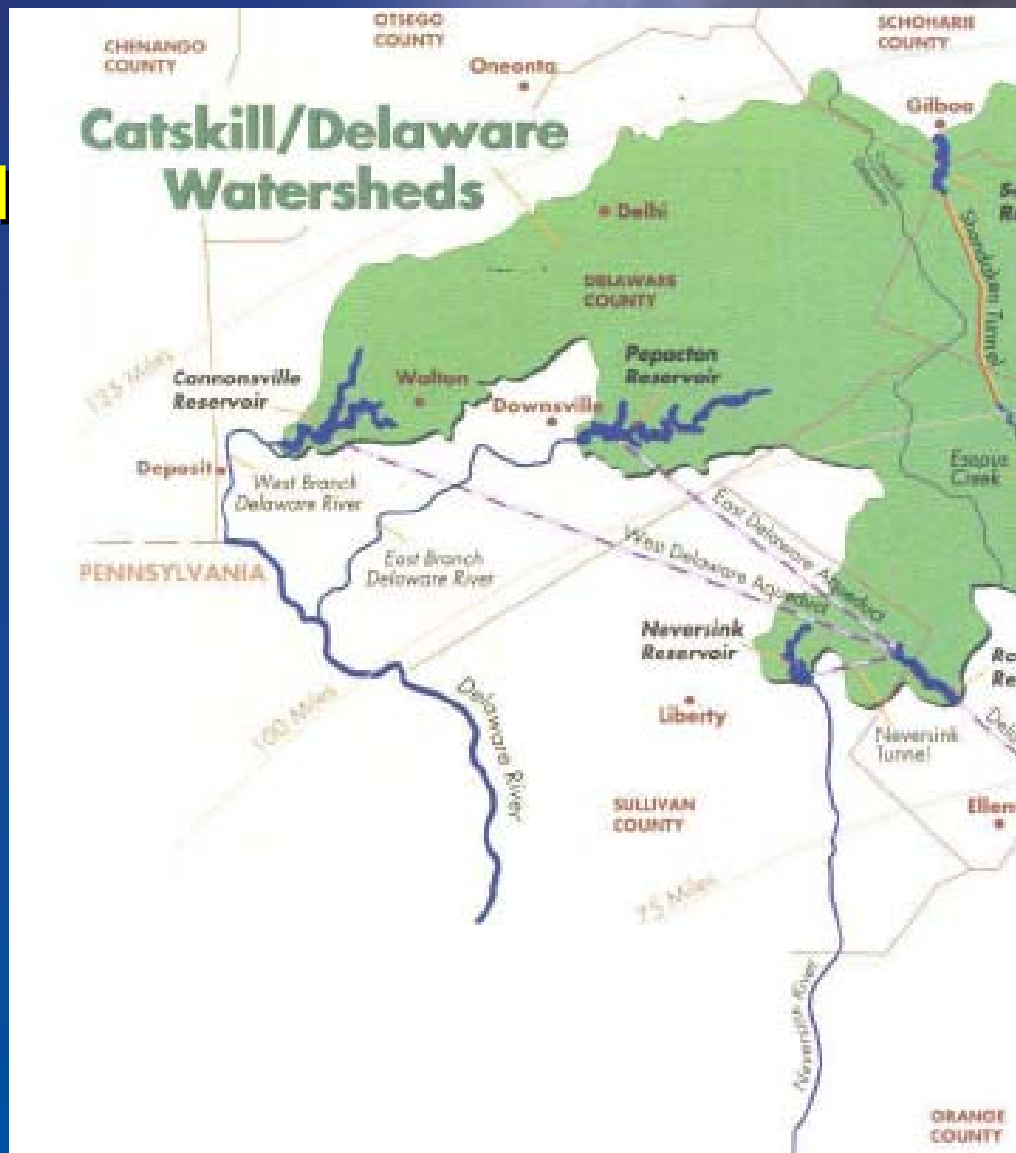


# Model simulation for 2005 Flood



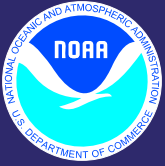
- Asked to provide a rough estimate of the impact on flood crests due to the existence of the following four reservoirs....

- *Cannonsville*
- *Pepacton*
- *Neversink*
- *Wallenpaupack*



# Model Simulation Results

## 2005 Flood



- For this event, our simulations indicate that even though these dams spilled, crest levels would probably have been higher if the four dams did not exist.
- – *Lower Delaware...0.5 to 1.5 foot higher crests without dams*
- – *Upper Delaware...1.0 to 2.5 foot higher crests without dams*
- ***REALITY – Reservoirs helped minimize floods***

# Rumor – Upstream Development Caused Flooding



- **The Facts...**

- ***Massive amount of rainfall, not development of any kind, again caused major river flooding***
- ***Developed lands increased slightly (0.4%) between 1973 and 2000, primarily in the eastern portion of the ecoregion where the proximity to the Poconos and Catskills regions makes it possible for individuals to have second homes and still live and work near New York City. Ref: USGS Report “Contemporary Land Cover Change in the North Central Appalachians Ecoregion” by Kristi L. Saylor***
- ***There's still vast areas of the Poconos, northwest New Jersey and the Catskill Mountain region where the main Delaware stem is still just forest. Between 1973 and 2000 forest cover for the North Central Appalachian ecoregion decreased 0.8% to 86.7% (ref: USGS, Saylor)***
- ***Let's double-check this by going to the satellite imagery***
- ***Courtesy of [maps.google.com](http://maps.google.com)***

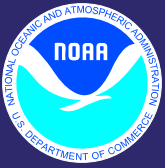


**Satellite Image of Lake Wallenpaupack  
([maps.google.com](https://maps.google.com))**

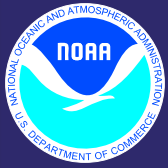


**Satellite Image of Cannonsville and Pepacton Reservoirs  
([maps.google.com](https://maps.google.com))**

# Rumor – Upstream Development Caused the Flooding



- **REALITY –**
- **Upstream basin area contains huge tracts of undeveloped land**
- **NWS computer models are not requiring adjustment due to land development upstream on the Delaware**
- **Most important cause of flooding was excessive rainfall**

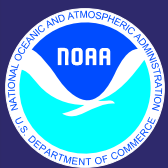


# Rumor – Flood was caused by Global Warming



- **No individual weather event can be attributed to global warming or climate change**
  - *You cannot say that a ‘hurricane’ or a ‘heat wave’ or a ‘flood’ was caused by global warming*
- **The June 2006 flood event cannot be directly attributed to ‘global warming’ or ‘climate change’**

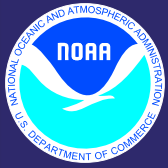




# Why are we flooding so often?



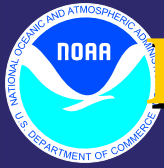
- **Because it has been wetter**
- **Because we have had more major rain events**
- **Very rare extreme rainfall events have occurred with greater frequency**
  - *Why? Look to the tropics*
  - *2004 Flood – Remnants of Hurricane Ivan*
  - *2006 Flood – Remnants of tropical low which came ashore over North Carolina and moved north up the Delaware Valley*



# Why are we flooding so often?



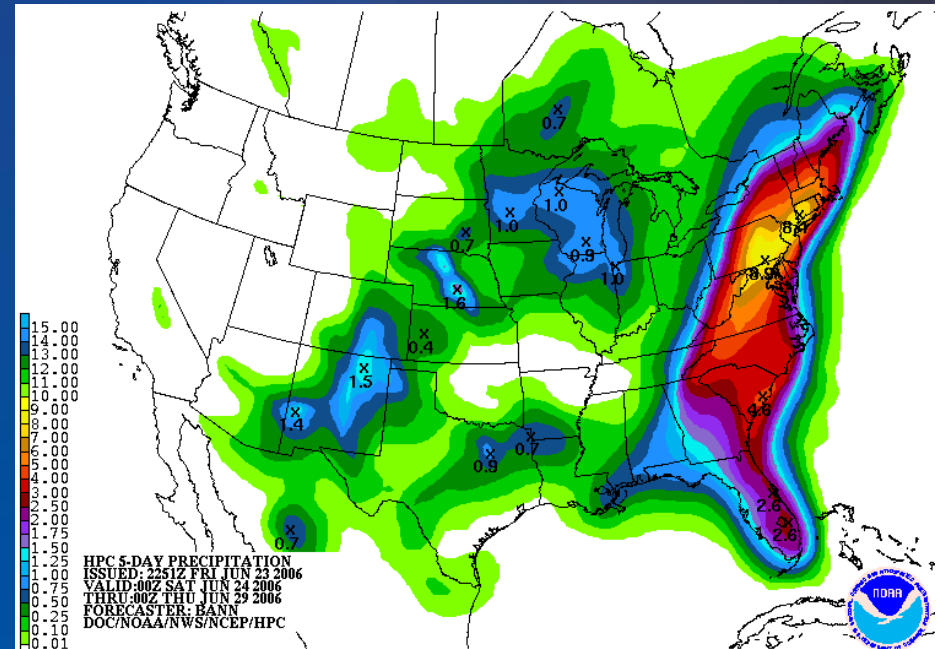
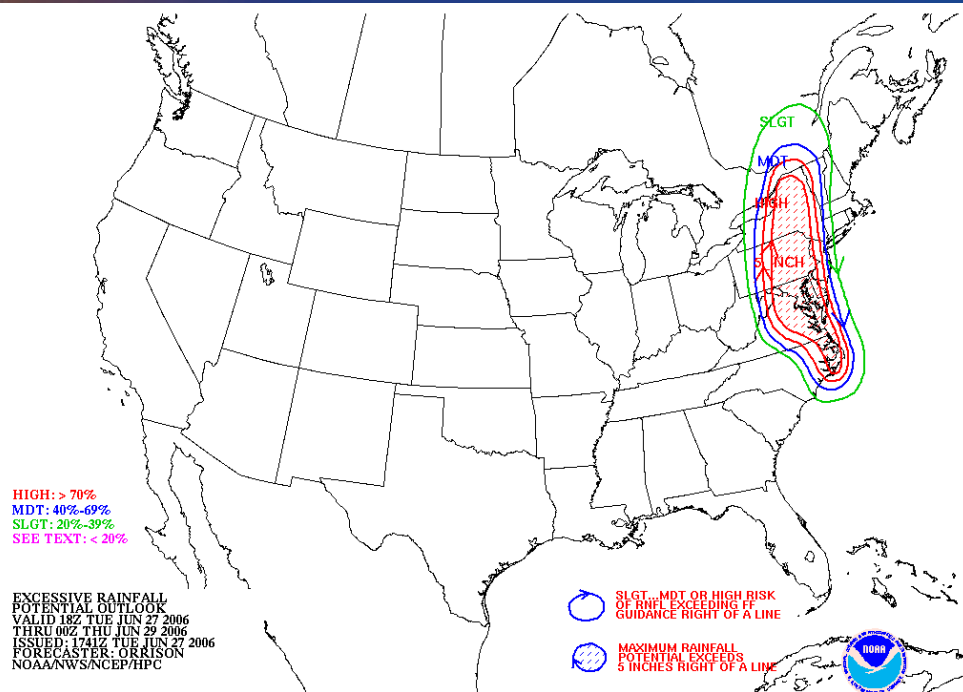
- We have been in an active pattern for Atlantic basin hurricanes since 1995
- We believe the 2006 season will be another active one, with tropical cyclone activity close to twice the normal level
- It is possible that a slow moving tropical system or series of tropical systems striking the region could result in another episode of major flooding this year.

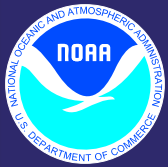


# How to prepare for the next big flood?

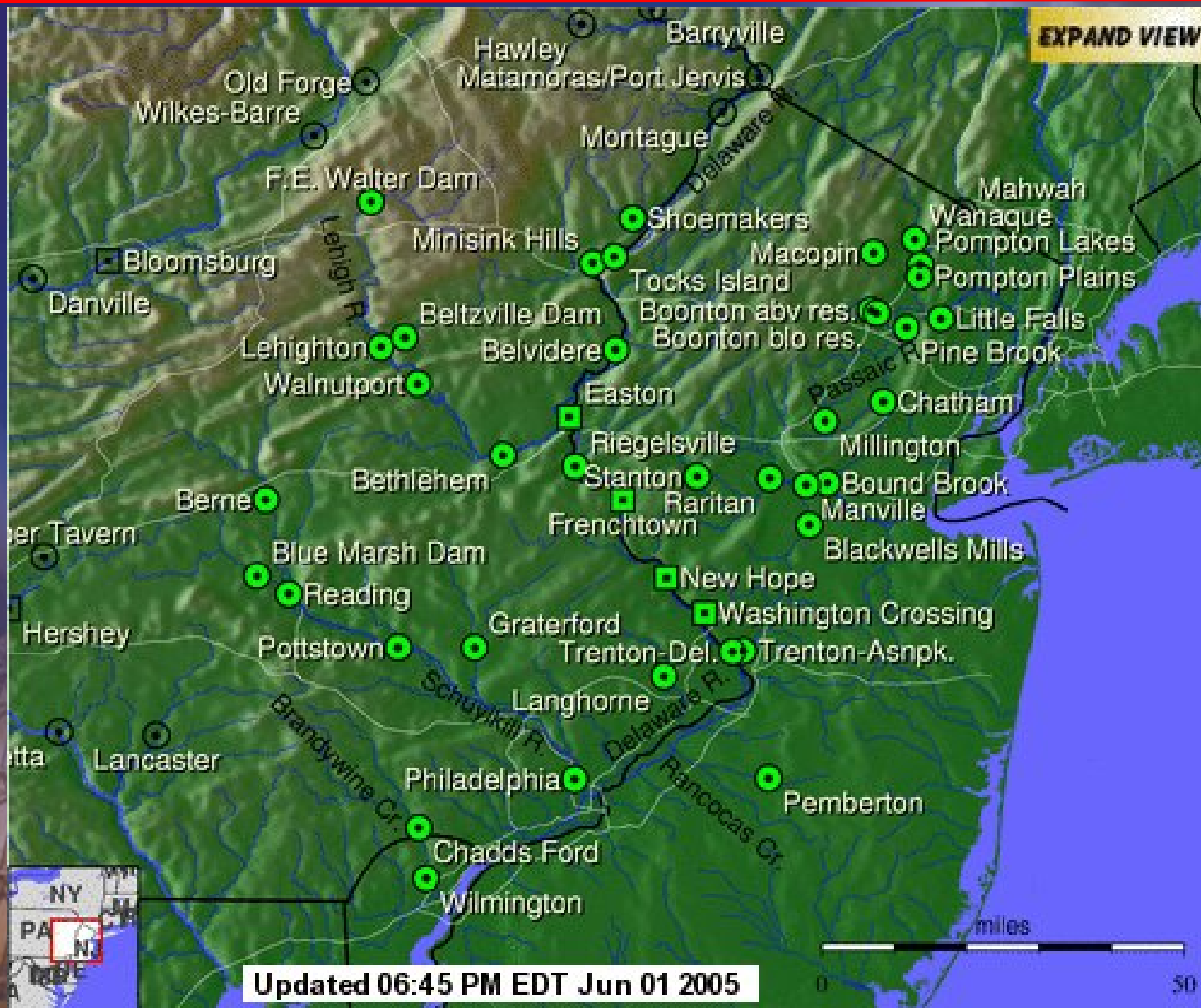


- Stay informed – [weather.gov/marfc](http://weather.gov/marfc)
- Use AHPS (Automated Hydrologic Prediction System)





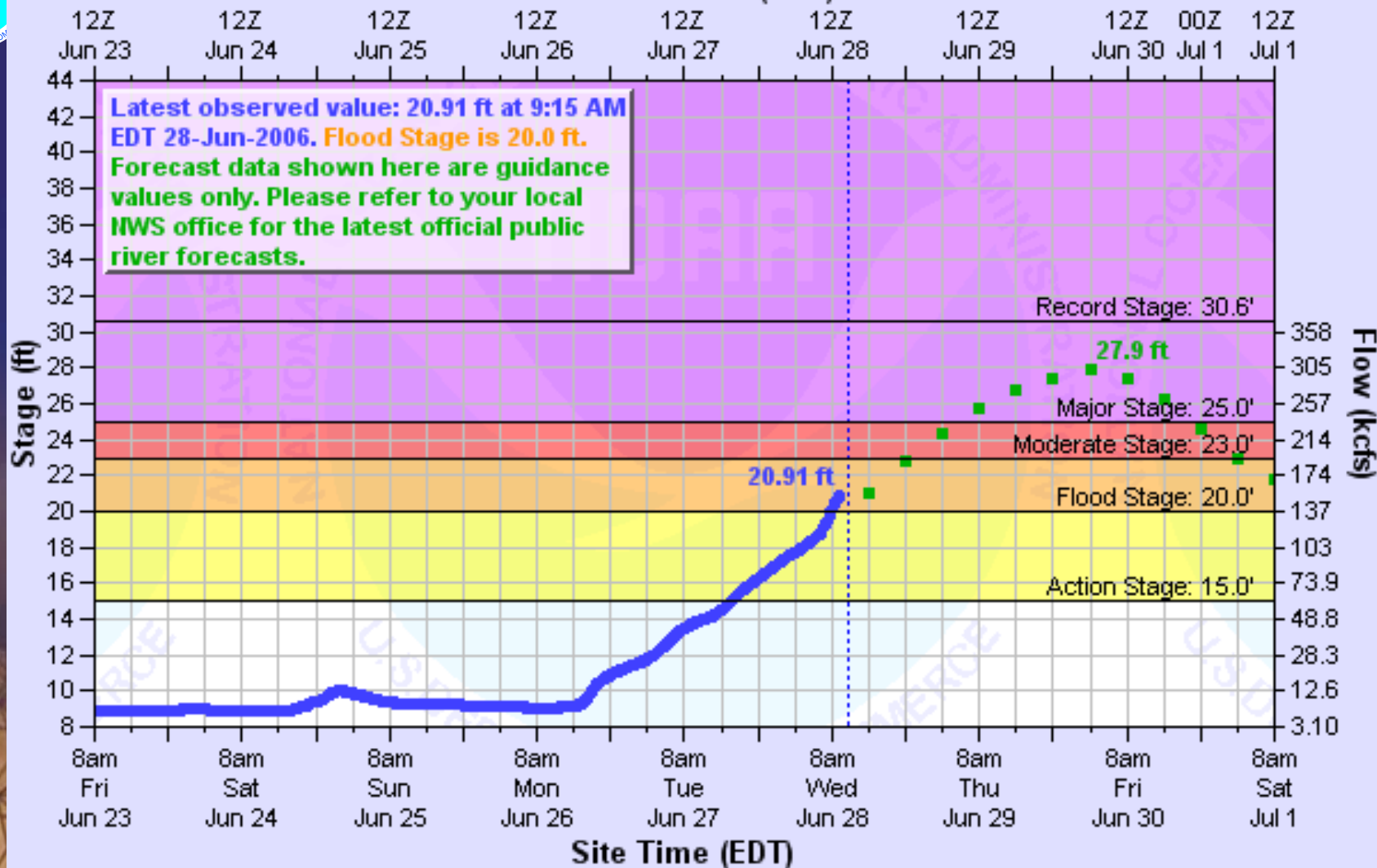
# AHPS





# DELAWARE RIVER AT Trenton

Universal Time (UTC)

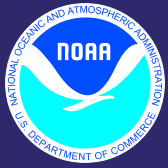


Latest observed value: 20.91 ft at 9:15 AM EDT 28-Jun-2006. Flood Stage is 20.0 ft. Forecast data shown here are guidance values only. Please refer to your local NWS office for the latest official public river forecasts.

--- Graph Created (10:46am Jun 28, 2006)    ● Observed    ■ Forecast (issued 9:37am Jun 28)

TREN4 (plotting HGIRG) "Gage 0" Datum: n/a'

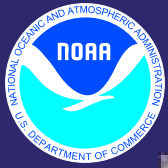
Observations courtesy of the US Geological Survey



# Contact information



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Email [gary.szatkowski@noaa.gov](mailto:gary.szatkowski@noaa.gov)  
Work 609-261-6602 x222
- **Internet websites**
  - [Weather.gov/marfc](http://Weather.gov/marfc)
  - [Weather.gov/phi](http://Weather.gov/phi)
  - [Weather.gov/bgm](http://Weather.gov/bgm)
  - [Weather.gov/ahps](http://Weather.gov/ahps)
    - **Advanced Hydrologic Prediction System web page**
- **NOAA Weather radio**
- **609-261-6600 – phone recordings (lower Del)**
- **607-729-1597 – phone recordings (upper Del)**



# The End

