Northwest Flow Snow
in Western North Carolina

National Weather Service

Greenville-Spartanburg Airport

Greer, SC

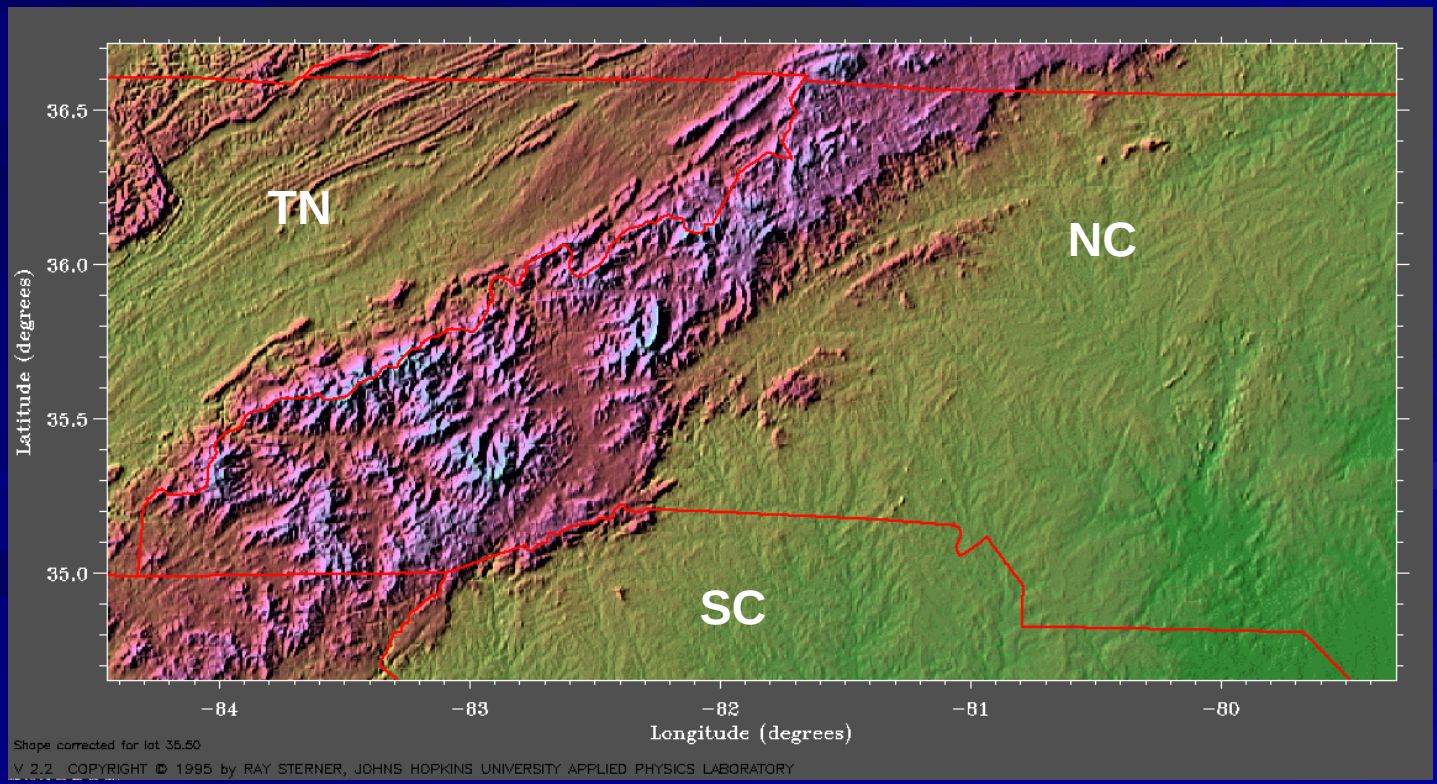
20 January 2006

Prepared for a broadcast media seminar

in Asheville, NC

What is Northwest Flow Snow?

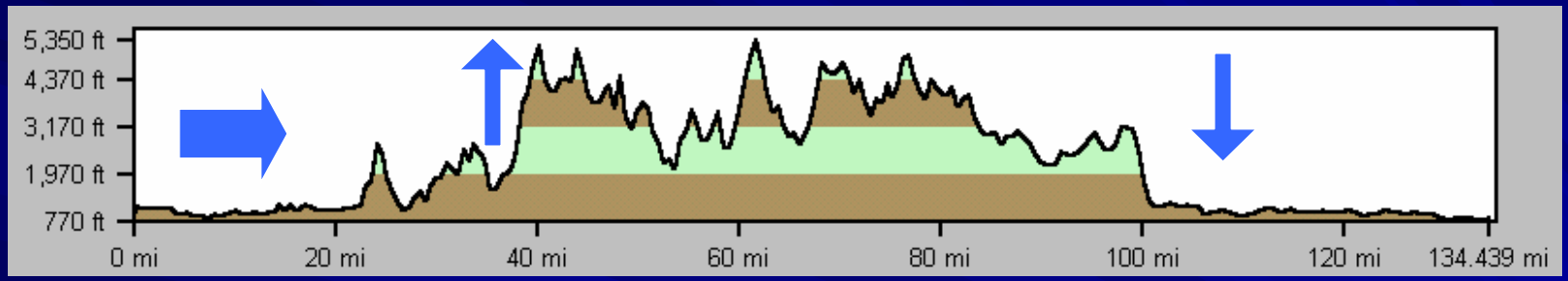
- Snowfall in WNC occurring during periods of low-level upslope (northwest) flow across the southern Appalachians



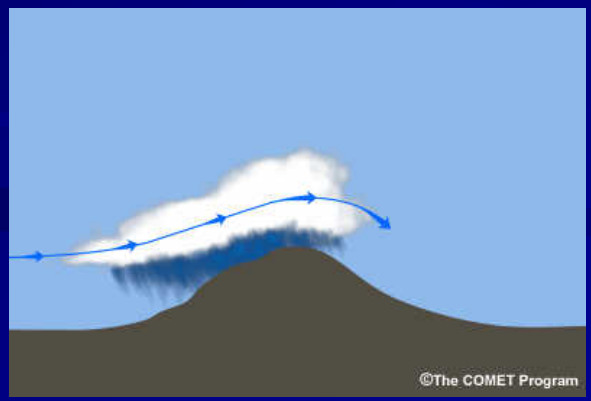
Upslope Flow

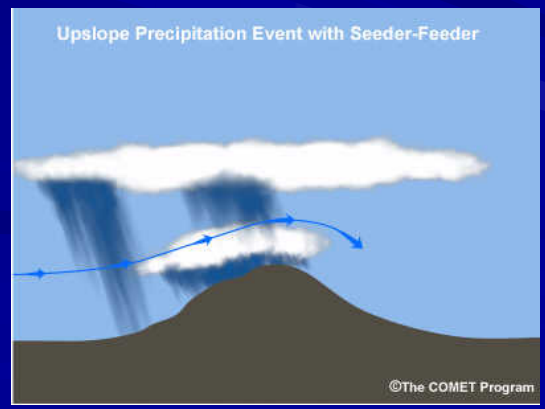
Along the North Carolina / Tennessee border

Elevation increases of 4000 ft to 5000 ft occur over very short distances

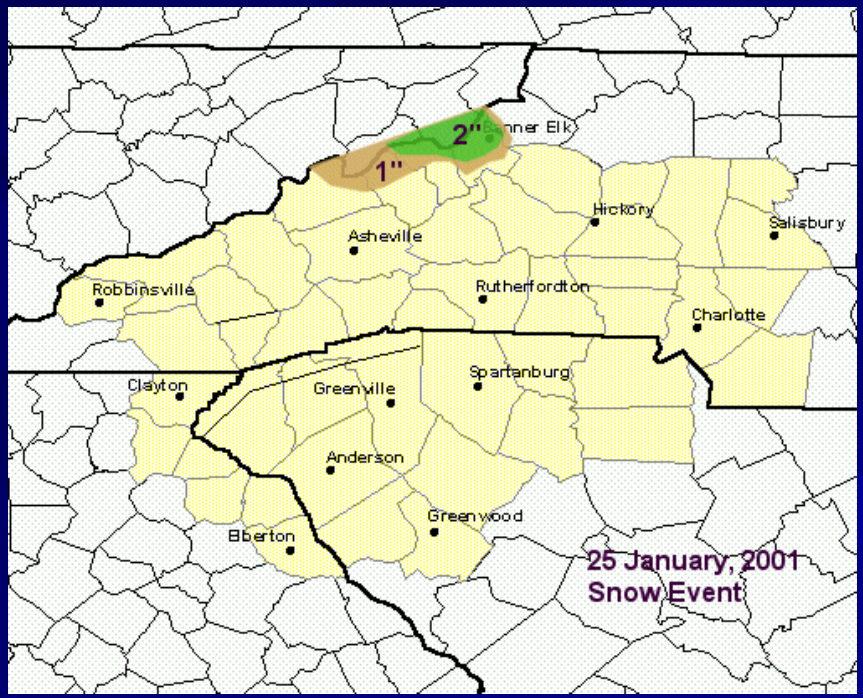


Knoxville NC Mountains Greenville

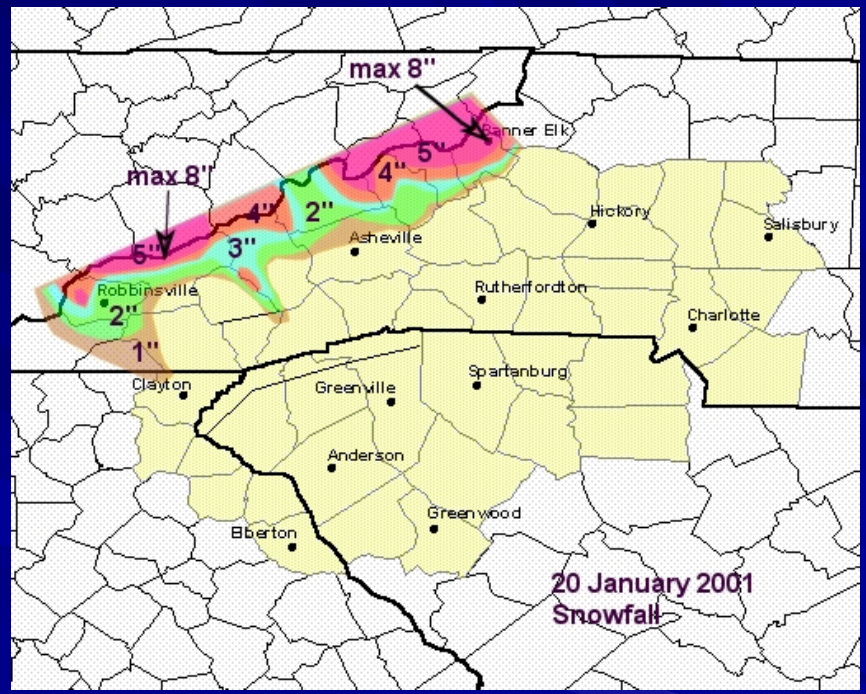




Northwest Flow Snow

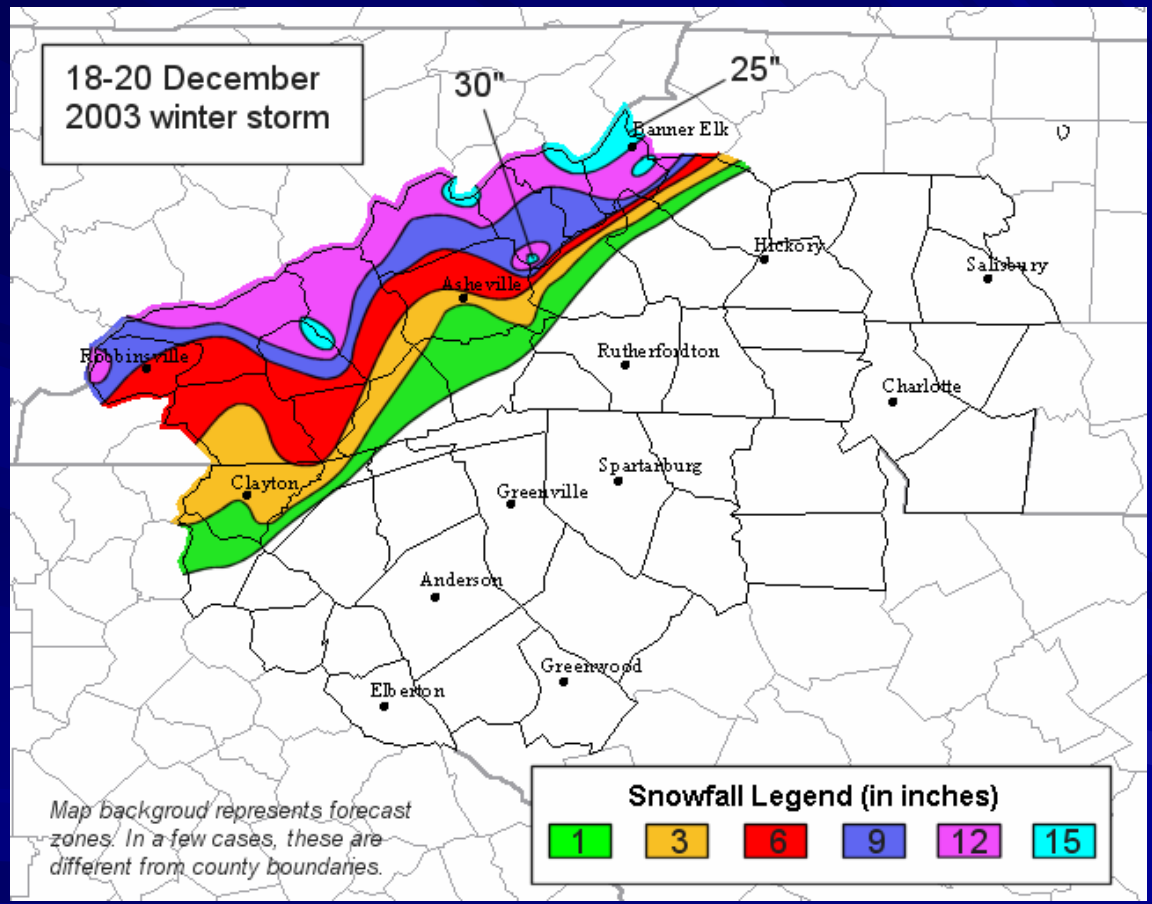


Minor Event



Moderate Event

Northwest Flow Snow



Major Event

Primary Characteristics

- Forced by orography
- Often not associated with extratropical cyclone precipitation shield
  - Synoptic scale environment can be dominated by forcing promoting downward motion
  - Occasionally… troughs embedded in northwest flow enhance snowfall (e.g., 18-20 December 2003)
- Snowfall distribution quite irregular and accumulations highly variable
  - Sometimes only flurries
  - Sometimes warning criteria

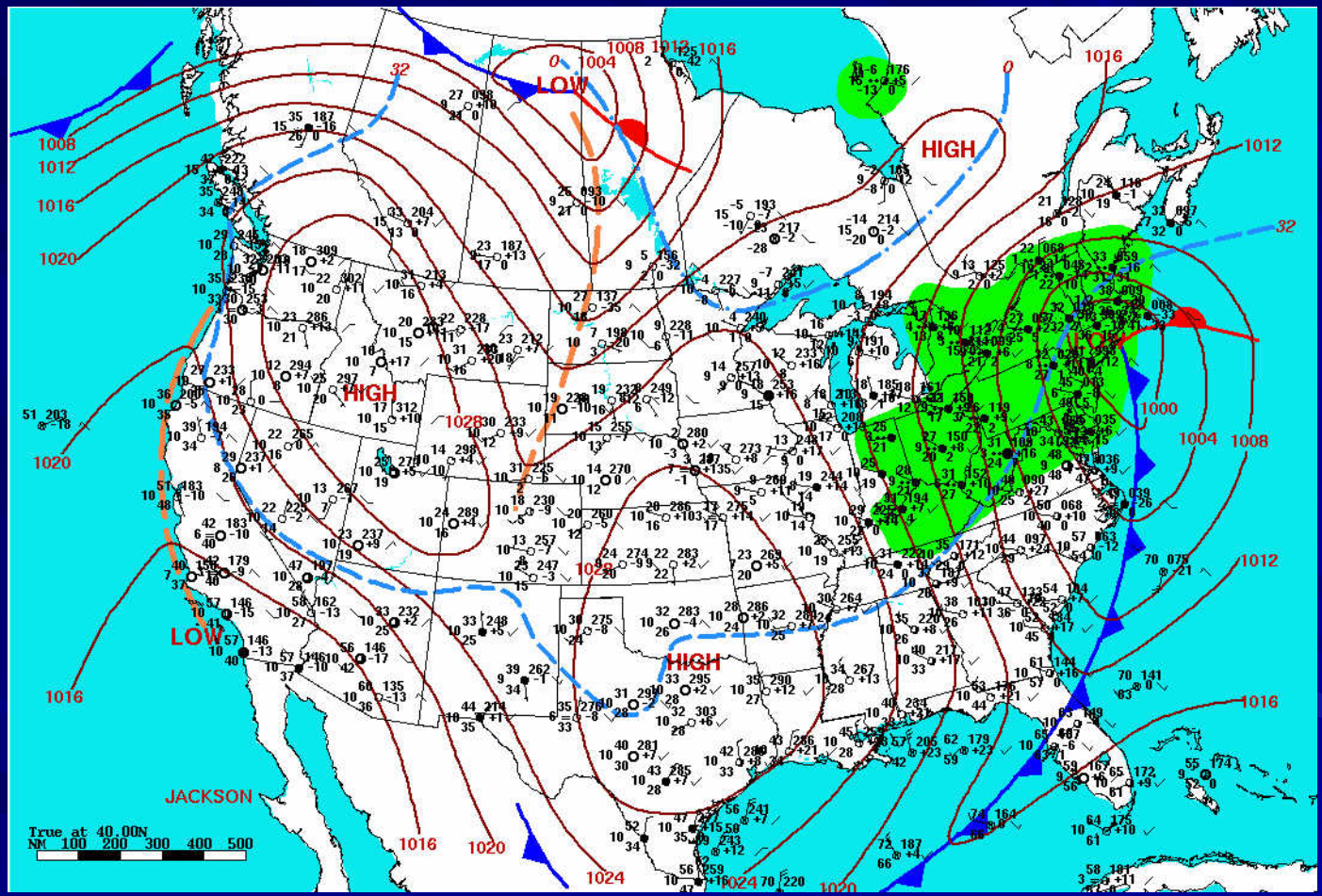
Categories

- **Post Frontal**
  - **“Classical” northwest flow snow in WNC**
  - **Strong winds**
    - **Blowing and Drifting**
- Comma Head
  - (“Wrap Around”)
- Cut-Off Low
  - Late winter and early spring

Buckner Gap (Elev. 3370 ft) - Interstate 26

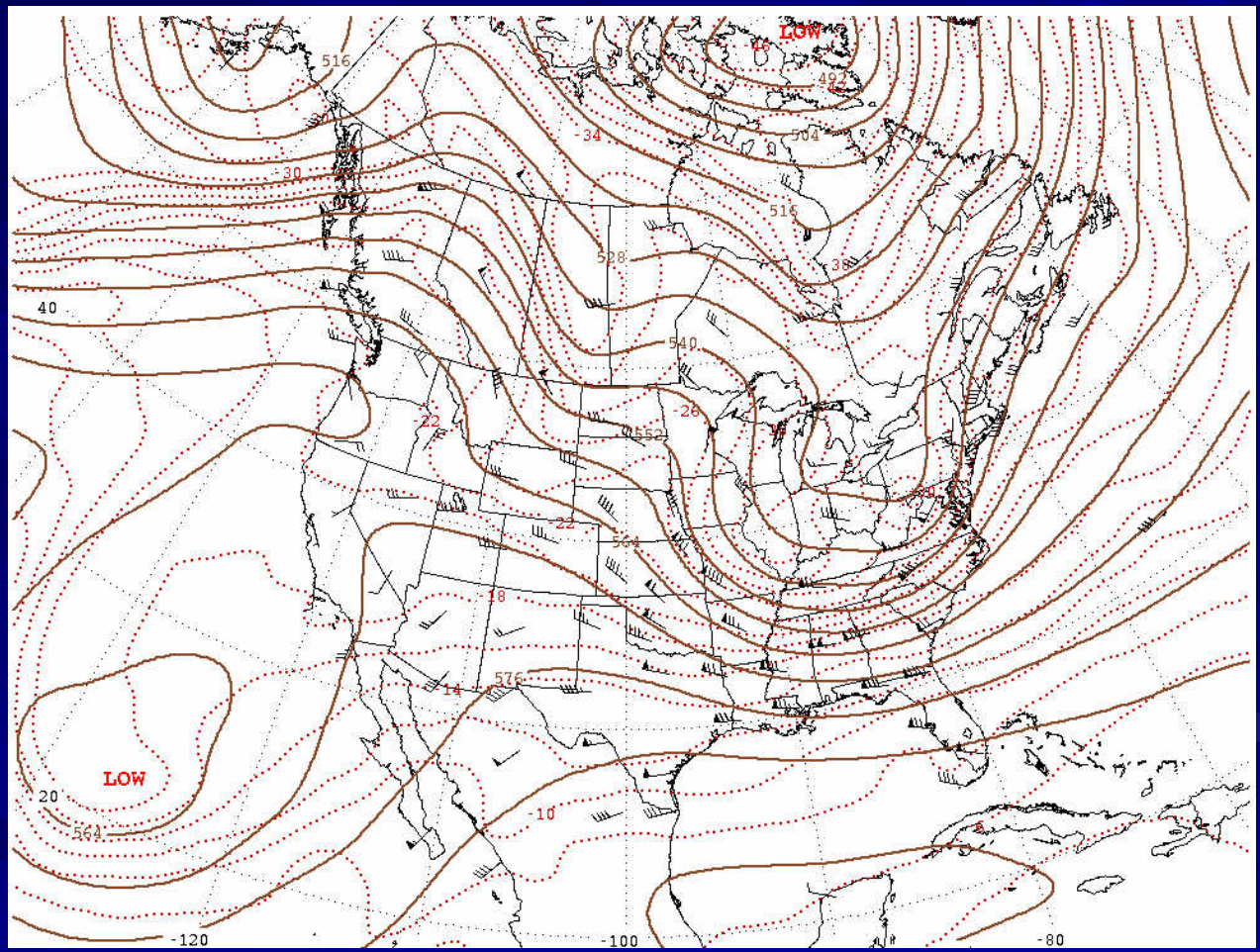
Madison County (Photo: NCDOT)

Post Frontal

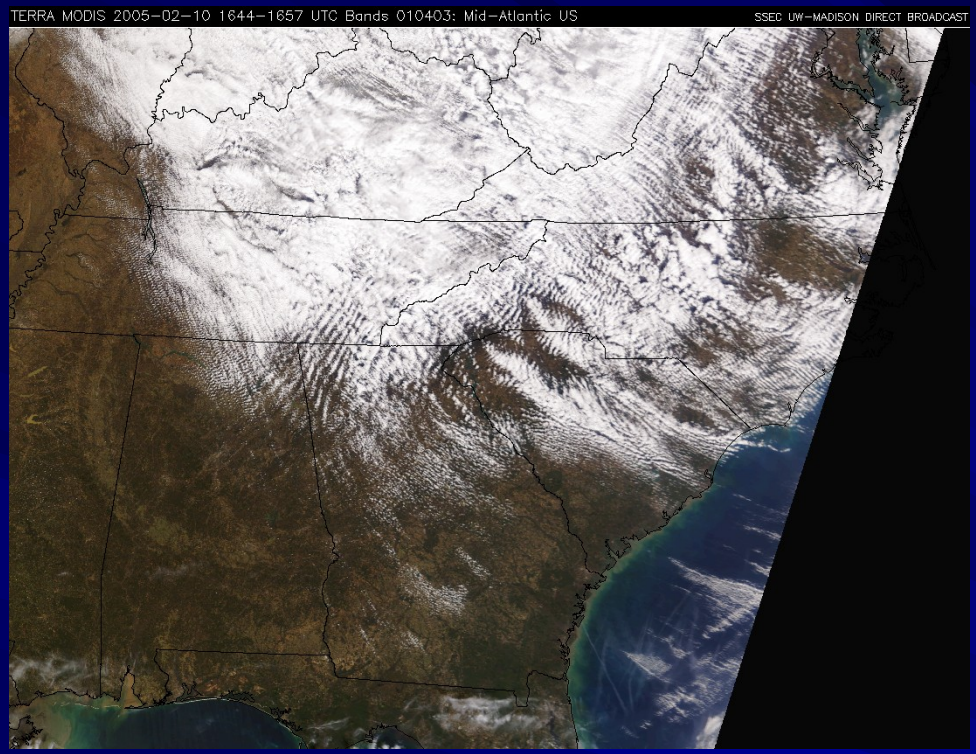


HPC Surface Analysis - 1200 UTC 10 February 2005

Post Frontal



HPC 500 mb Analysis - 1200 UTC 10 February 2005



TERRA MODIS – 10 February 2005 – 1644 - 1657 UTC

SSEC UW-Madison

View from Purchase Knob

5086 ft MSL

Haywood County

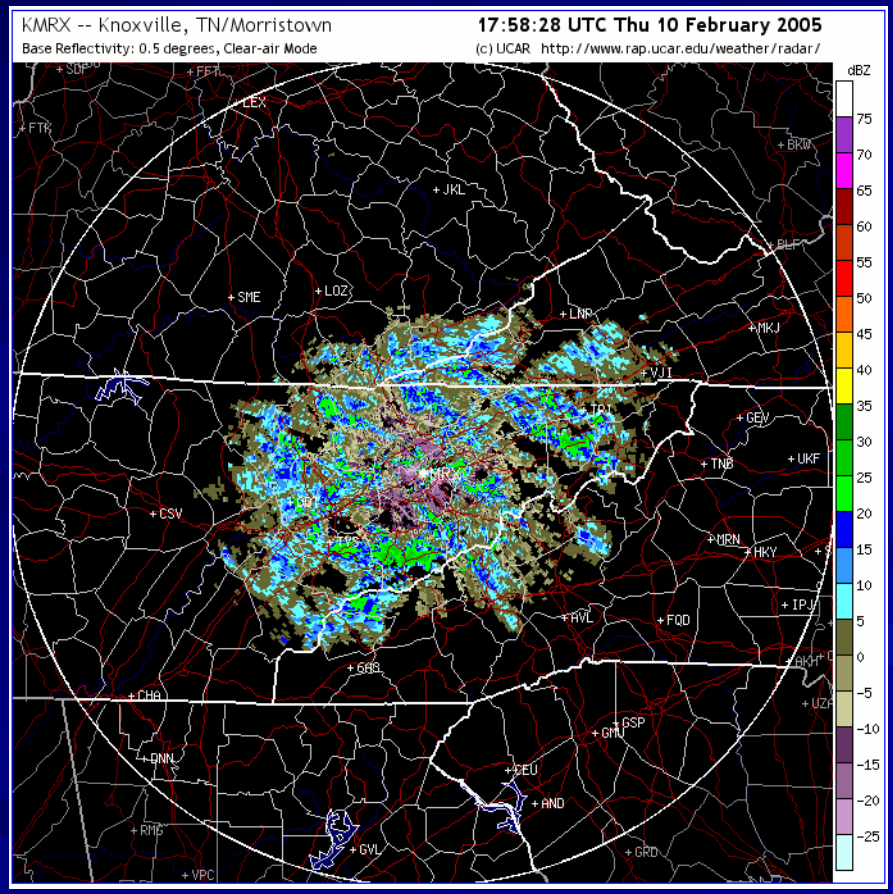
Toward the Northeast

10 February 2005

2000 UTC

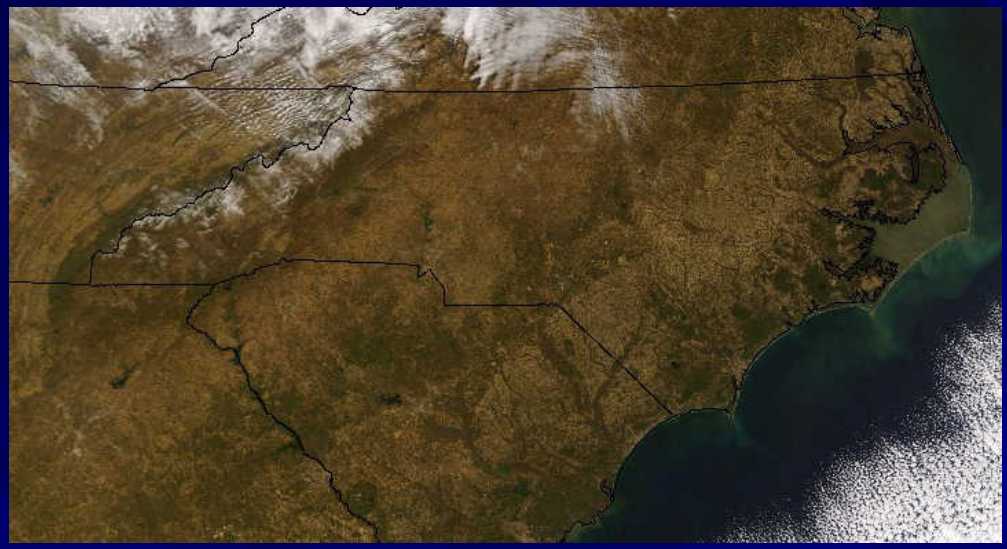
NPS/DOI

Northwest Flow Snow Base Reflectivity



MRX (Morristown) - 1758 UTC

10 February 2005



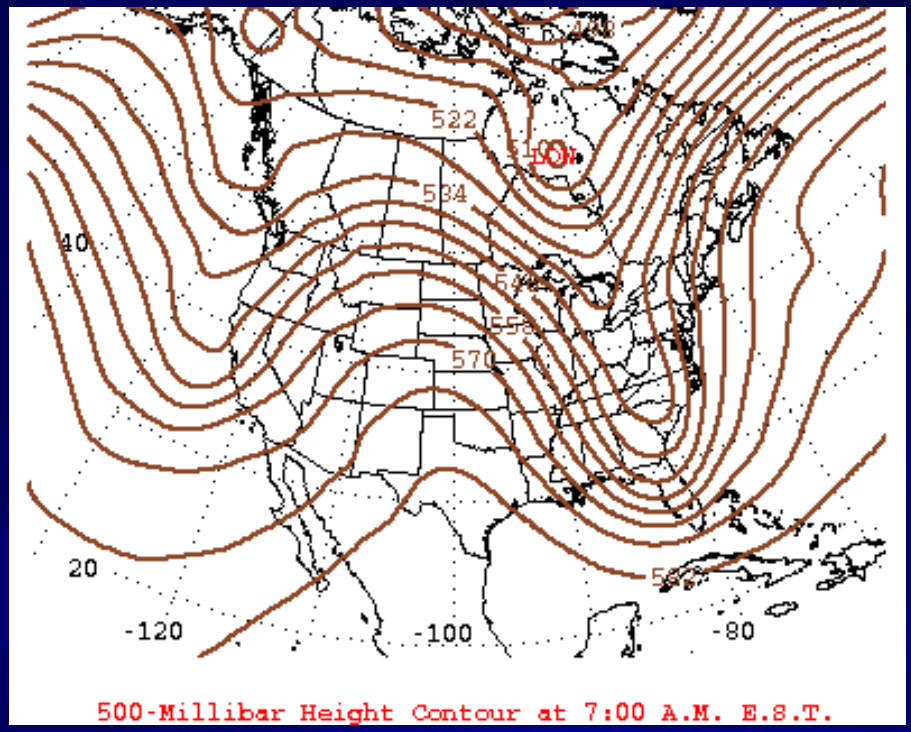
TERRA MODIS - 11 February 2005 - 1550 – 1601 UTC

SSEC UW-Madison

View from Purchase Knob

11 February 2005
2000 UTC

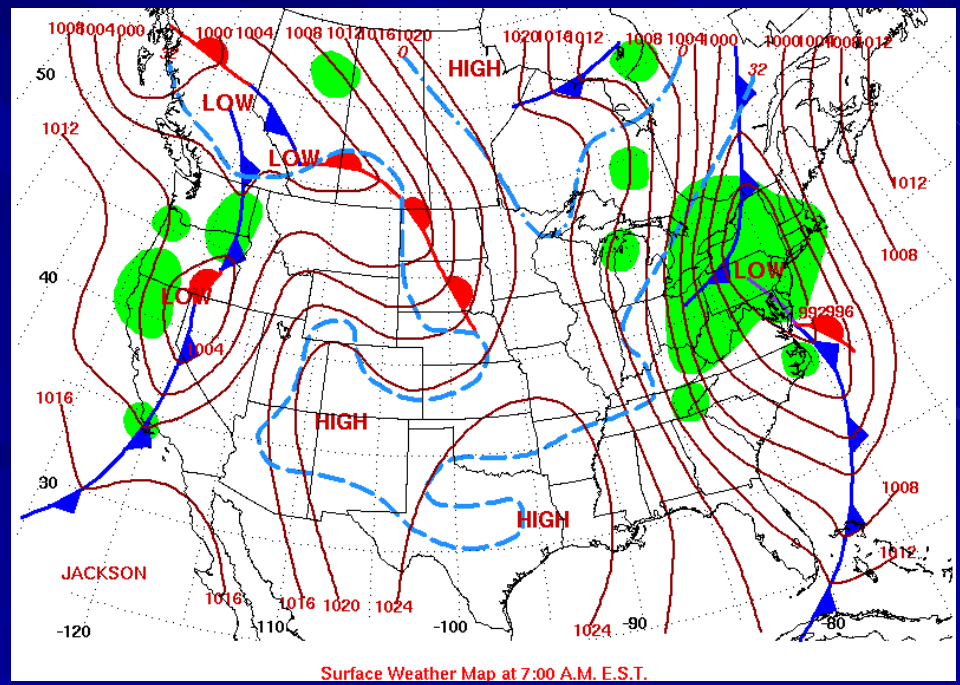
NPS/DOI



500 mb

1200 UTC

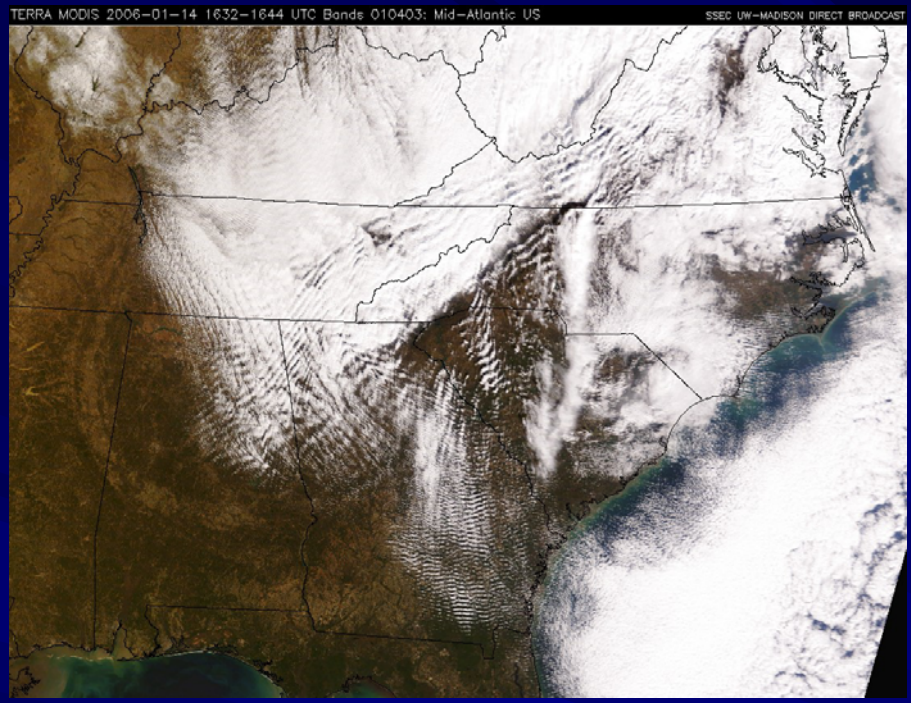
Saturday – 14 January 2006



Surface

1200 UTC

Saturday – 14 January 2006



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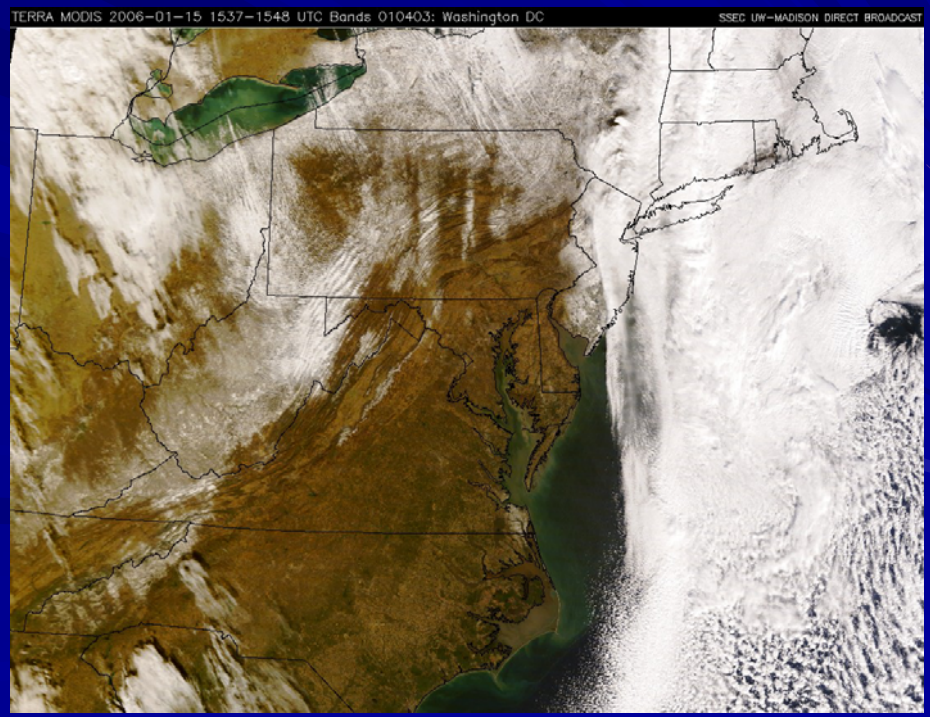


Sunday – 15 January 2006

Images: SSEC UW-Madison

Fundamental Forecast Considerations

- Horizontal and vertical extent of post frontal moisture
  - Flurries and snow showers west of mountains
- Temperature
- Stability
- Wind direction and wind speed
- Upwind short waves embedded in NW flow

Cloud and Precipitation Physics

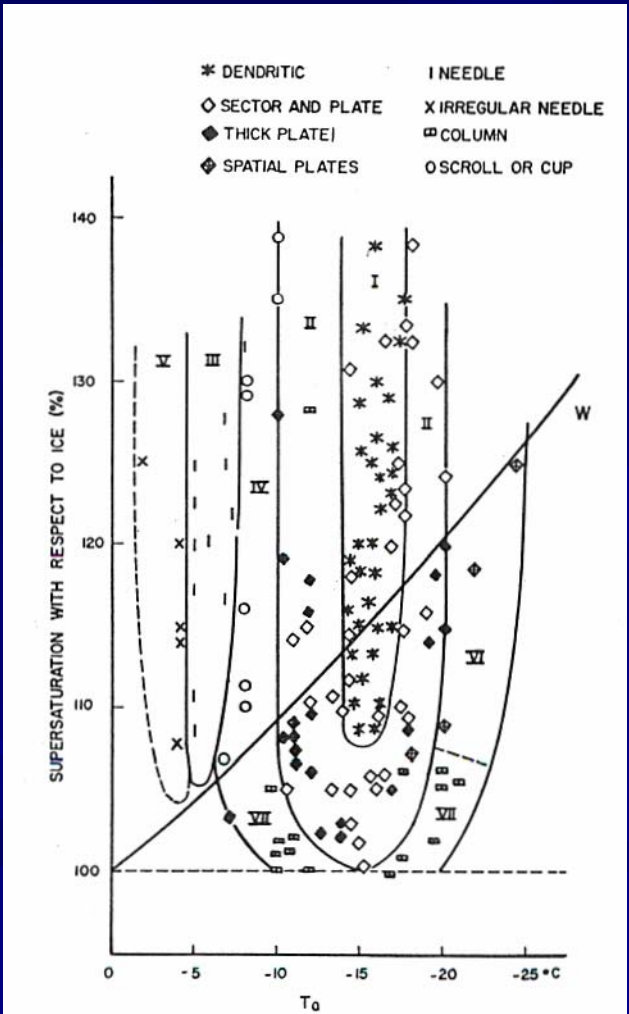
- Clouds should extend to –15°C (✂ 2 or 3 degrees) for most efficient generation of snowflakes (refer to Nakaya diagram)
  - Optimum production of dendritic snow crystals
  - Optimum diffusive growth rates of ice
  - Nakaya IR enhancement curve used at NWS GSP

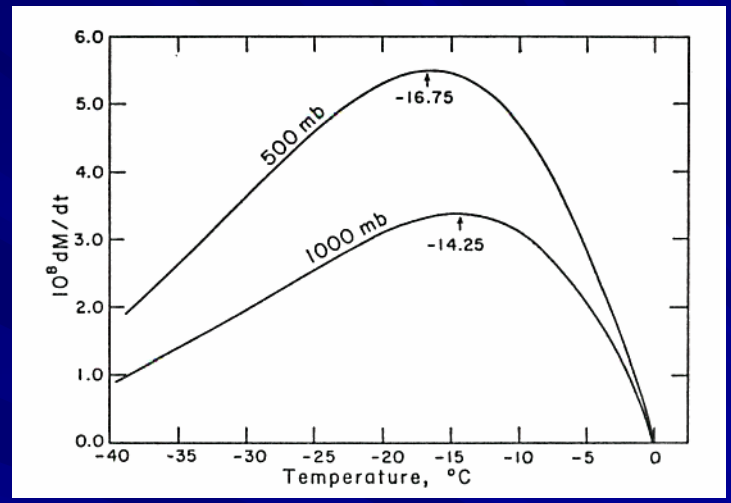
Jerzy Rutkowski (jerzyrut@uni.lodz.pl

Nakaya Diagram

and

Growth Rates of Ice Crystals





Growth rates as a function of temperature for ice crystal in water-saturated cloud at 1000 mb and 500 mb. Temperatures of maximum growth rate are indicated.

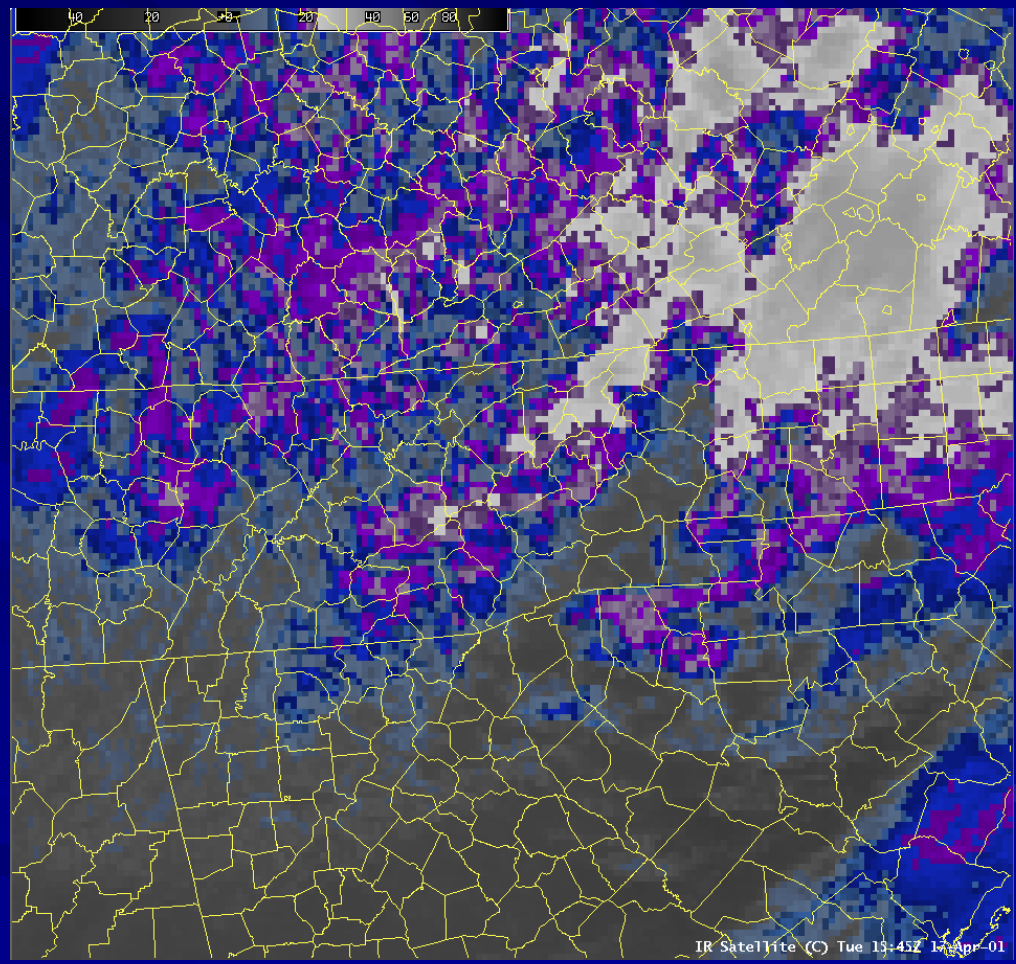
⇐ Nakaya Diagram

(Byers 1965)

IR Satellite Imagery (Nakaya Curve)

Light Blue…….. 0.0° C
Darker Blue… -10.0° C
Dark Blue…… -13.0° C
Purple…….. -17.5° C
Light Purple…. -20.0° C
Light Gray……-23.0° C

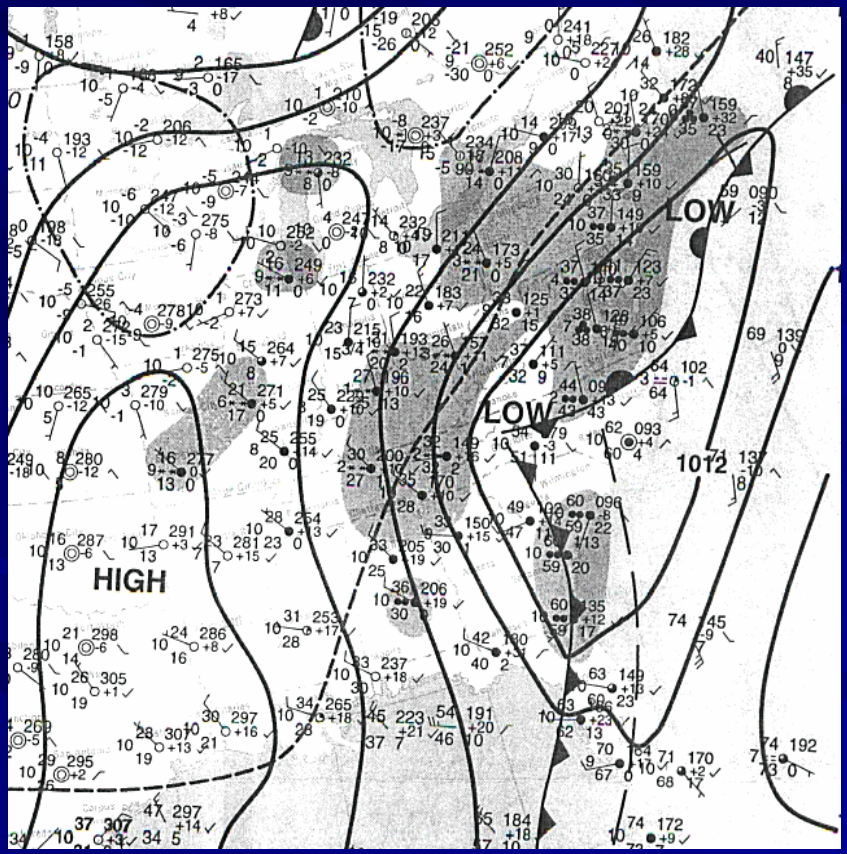
Dark Blue Highlights temperatures within +/-2°C of -15°C



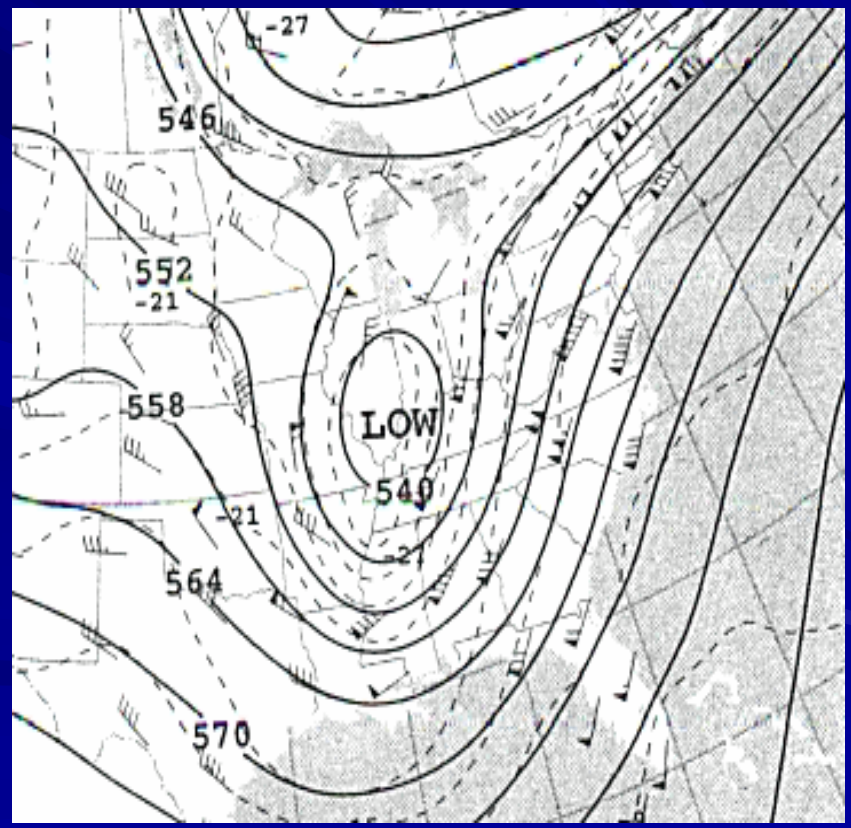
1545 UTC - 17 April 2001

Comma Head ("Wrap-Around") Event – 20 January 2001

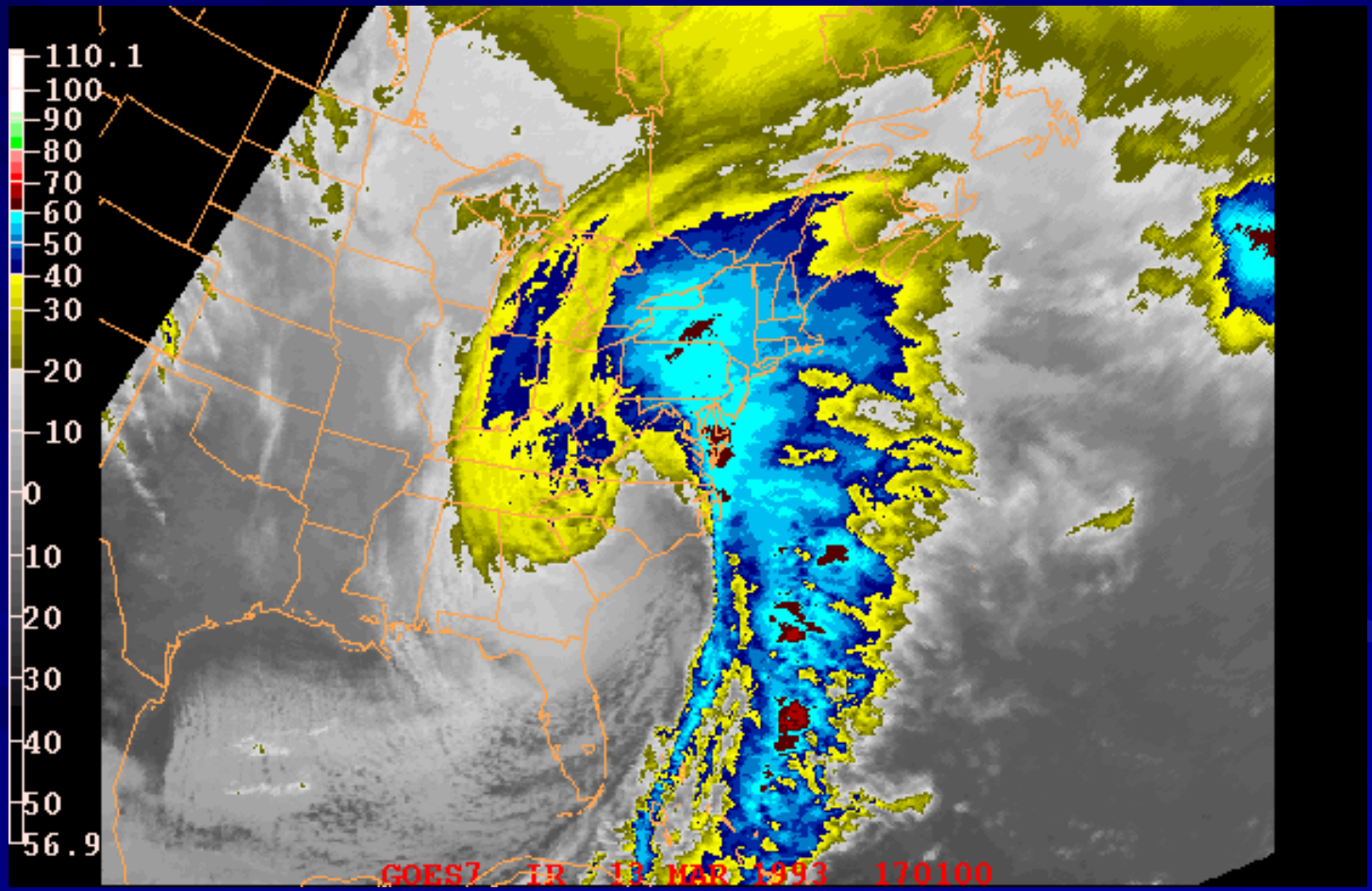
Surface



500 mb

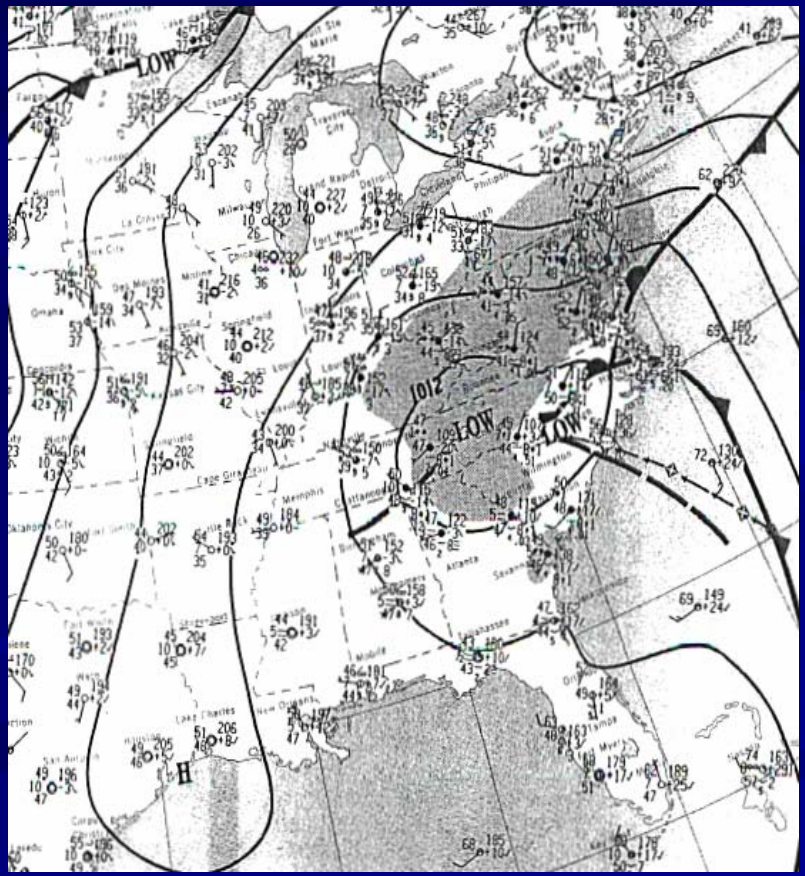


Storm of the Century
March 1993



Cut-Off Low – 8 May 1992

Surface



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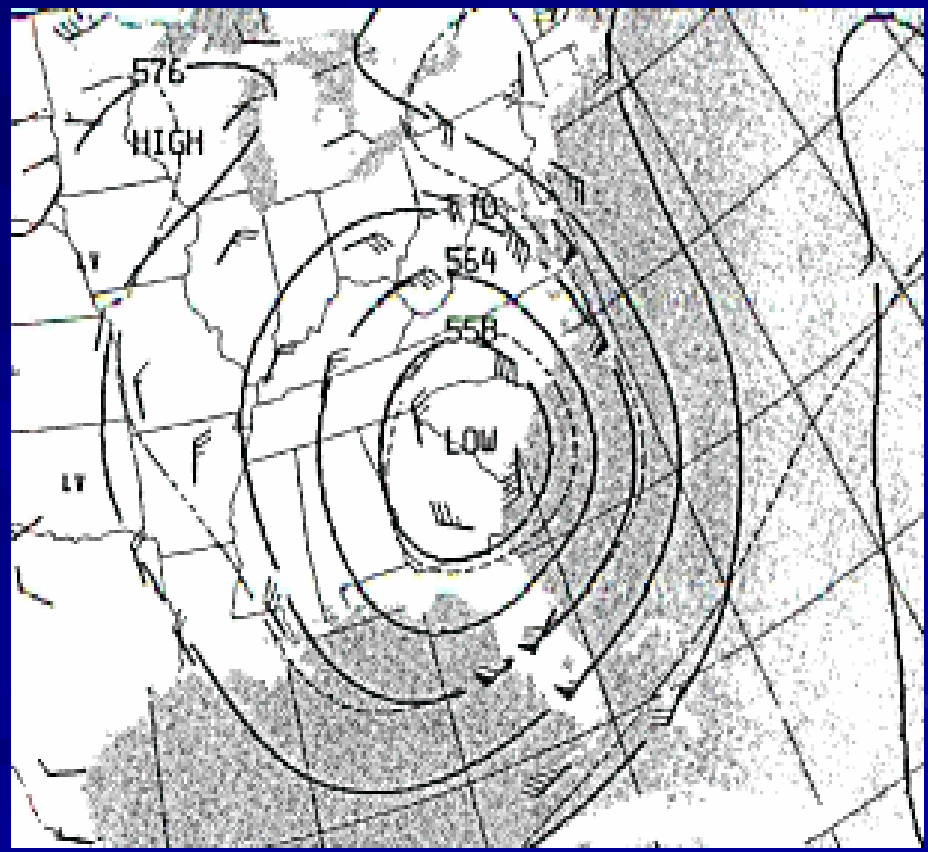
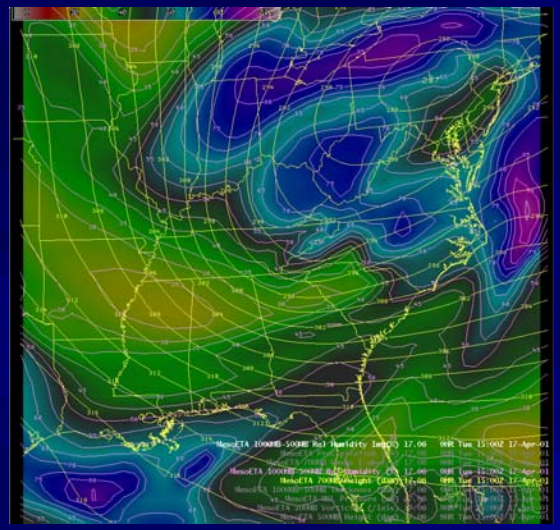
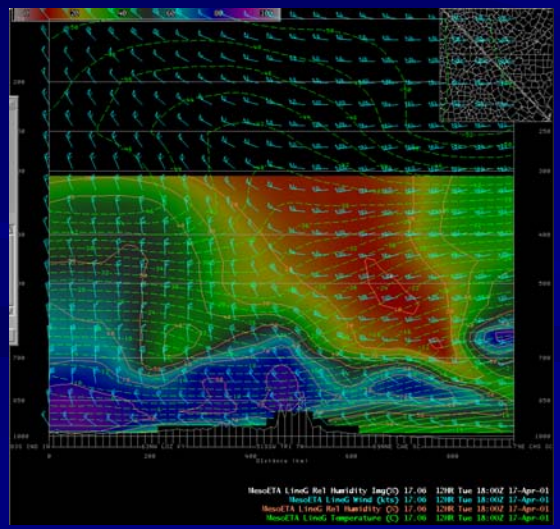


Model Guidance

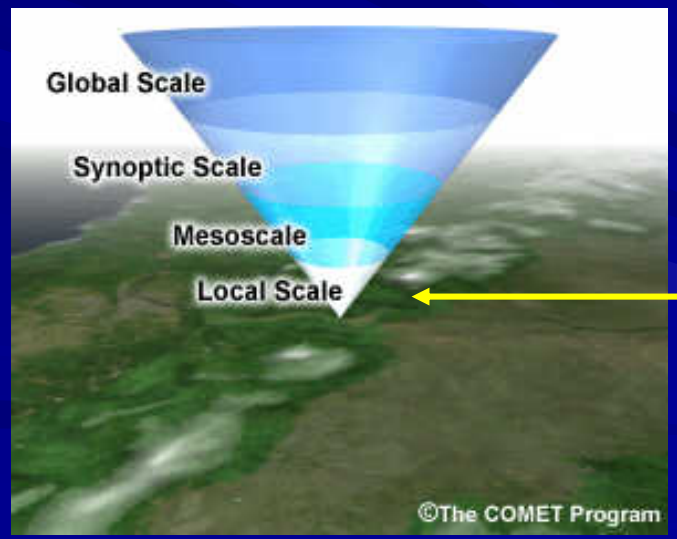




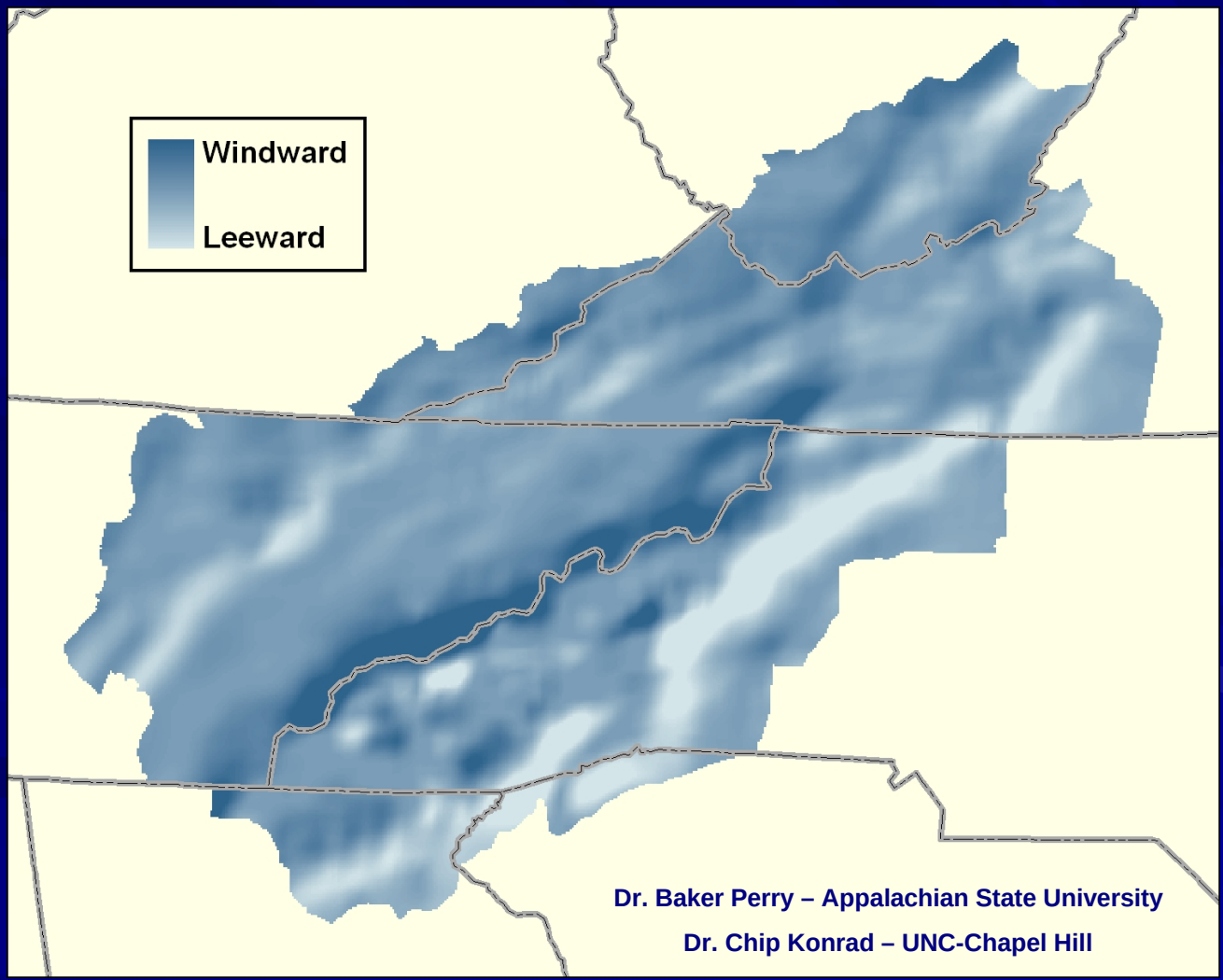
GFS – NAM – RUC

Reasonably good at depicting global and synoptic scale aspects of northwest flow snow events

Devil is in the details

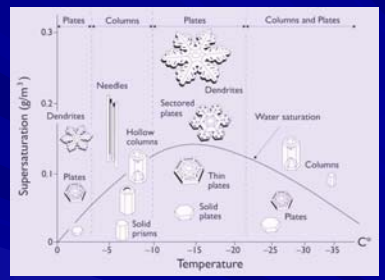


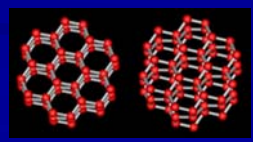
Windward and Leeward Slopes During Periods of Northwest Flow



Summary

- Northwest Flow Snow… Produced – or augmented by northwest, upslope flow across southern Appalachians
- Favors Tennessee border counties
- Often occurs in synoptic scale environments favoring downward motion
  - "Classical" (post-frontal)
    - Variable accumulation and areal distribution
  - Comma Head ("Wrap Around")
  - Cut-off Low
- Key ingredients
  - Considerable upwind low-level moisture
  - Low-level winds nearly perpendicular to terrain
  - Favorable cloud microphysical properties





References

- Supplied upon request
- http://www.its.caltech.edu/~atomic/snowcrystals/

THE END