

UMass Lowell Atmospheric Science Program

Celebrating our 50th Year!



UML Atmospheric Science

- 30 Undergraduates
- 5-10 M.S. Students
- Revised Curriculum to meet AMS, NWS requirements
- Undergraduate Research
- Opportunities for Field Work: Boston Marathon
Textile Regatta
Webpage Forecast

Snow Squalls in New England with a Changing Climate

Dr. Frank Colby

David Coe

Beth Krajewski

Alison Stokes



Why Snow Squalls?

- Snow Squalls happen here in Southern New England
- Affect us unexpectedly – traffic jams, accidents
- Climatology has not been understood



Webcam at State College, PA

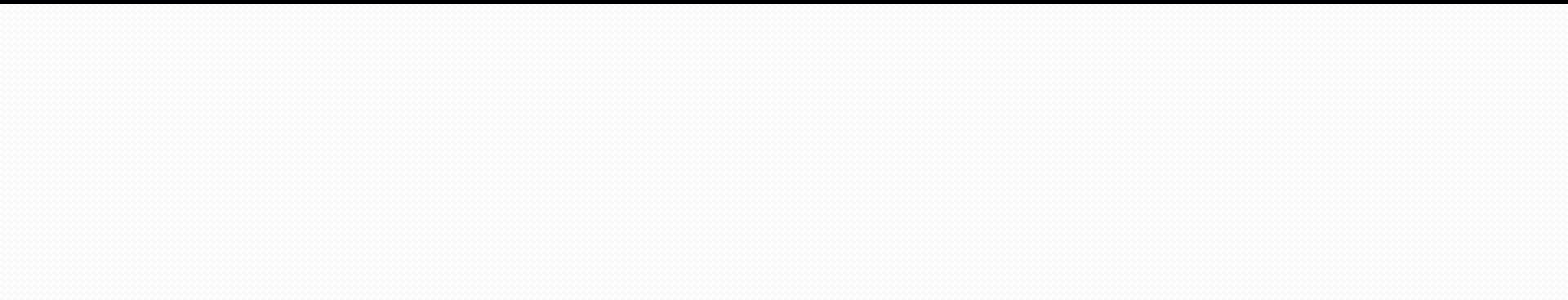
https://www.youtube.com/watch?feature=player_detailpage&v=Qf7LXukmQJM















And This is What Can Happen

With no Warning 40 Car Pileup – 10 Injuries



From Weather.com

With no Warning 35 Car Pileup – 12 injuries



What are Snow Squalls?

- **Snow Squall (NWS Glossary):** A snow squall is an intense, but limited duration, period of moderate to heavy snowfall, accompanied by strong, gusty surface winds and possibly lightning (generally moderate to heavy snow showers). Snow accumulation may be significant.

What are Snow Squalls?

- Environment Canada puts out Snow Squall Watches
“When conditions are favourable for the development of brief periods of very poor visibilities caused by heavy snow and blowing snow.”
- Some researchers call them “Snow Bursts”

What are Snow Squalls?

- We know that snow squalls are lines of snow showers, like a squall line but with snow instead of rain
- The snow falls intensely for a short time

What are Snow Squalls?

- They occur in many states:
 - NY, PA, VT, NH, ME, MA, CT, and even VA.
- Very little is known about them:
 - Jet Stream Pattern
 - Typical size, duration, speed
 - Direction of movement

Background

- Some recent research:
 - NWS paper examined observations at 3 locations: 2 in VT, and one in NY
 - McGill University – detailed analysis of 3 cases
- Earlier Research – Weir Lundstedt (NWS) Windex (1993) and Windex 2.0 (2005)
- My students and I wanted to understand the whole range of conditions and behaviors that occur with snow squalls

Our Snow Squall Working Definition

- In NWS Observations (Metar) Data:
 - Sudden Snow Event
 - Visibility drops below 2 miles
 - Wind Speed Increases, often Gusts Reported
- Inherent Limitation:
 - Events can be small in size, short in duration
 - Easy for events to be missed using Metar Data

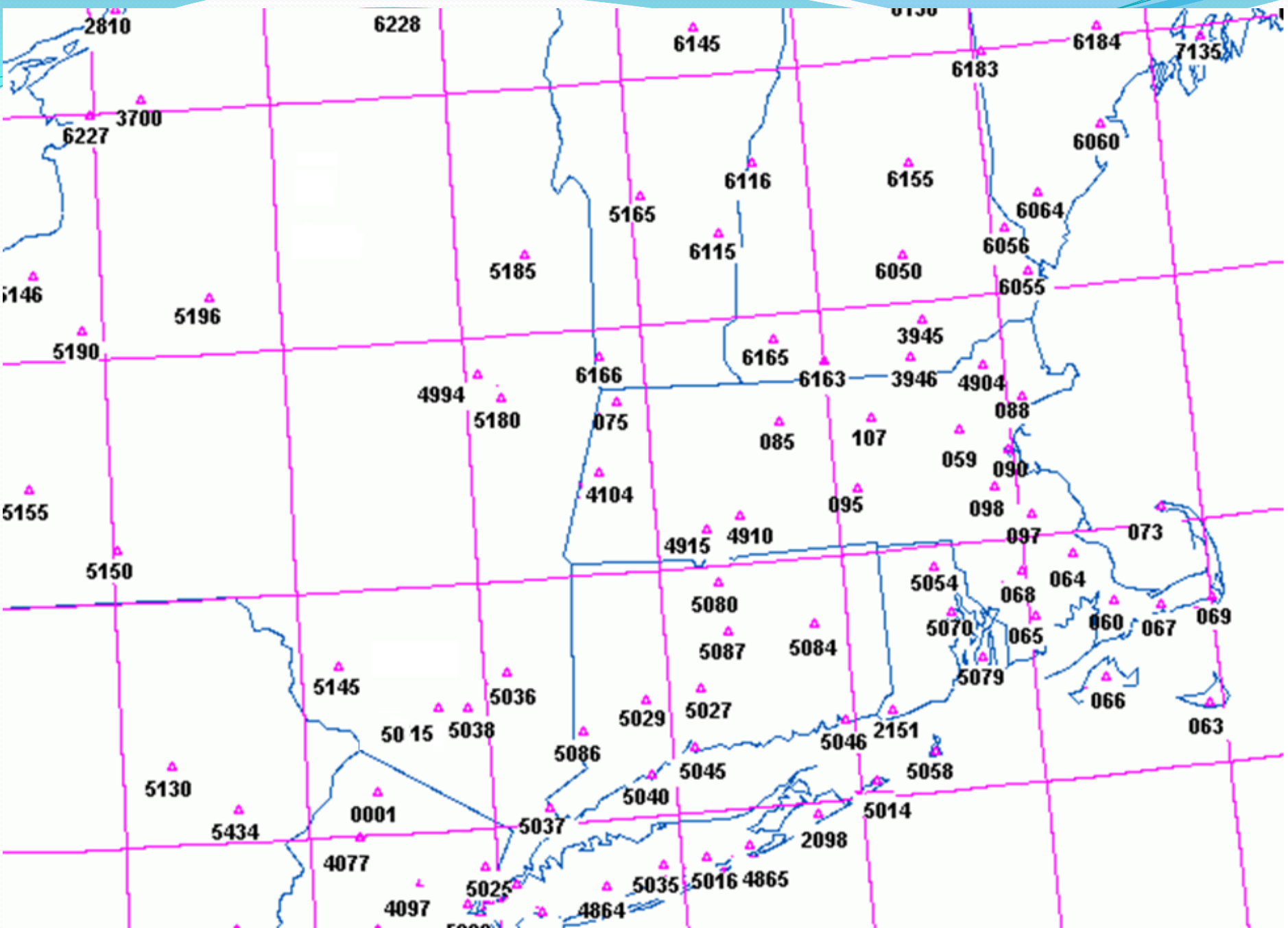
Our Research - UMass Lowell students

- Downloaded observations from National Centers for Environmental Information (formerly NCDC)
- Ran computer program to find:
 - Low visibility
 - Snow
- Examined output to find only sudden events
- Looked at weather maps to remove large storms
- Analyzed radar to confirm snow squall events

Scope of Research

- Southern New England:
 - southern VT and NH
 - eastern NY
 - CT , RI, and MA
- 20 years: 1997 – 2016
- Found 35 cases and characterized 4 types

Area of Our Search



Snow Squall Climatology

- Years:

- 1997: 2

- 1998: 0

- 1999: 0

- 2000: 0

- 2001: 2

- 2002: 1

- 2003: 3

- 2004: 4

- 2005: 0

- 2006: 3

- 2007: 3

- 2008: 1

- 2009: 2

- 2010: 1

- 2011: 2

- 2012: 2

- 2013: 5

- 2014: 1

- 2015: 2

- 2016: 1

Snow Squall Climatology

- Months:
 - November 0
 - December 4
 - January 9
 - February 13
 - March 9
 - April 0

Typical Characteristics

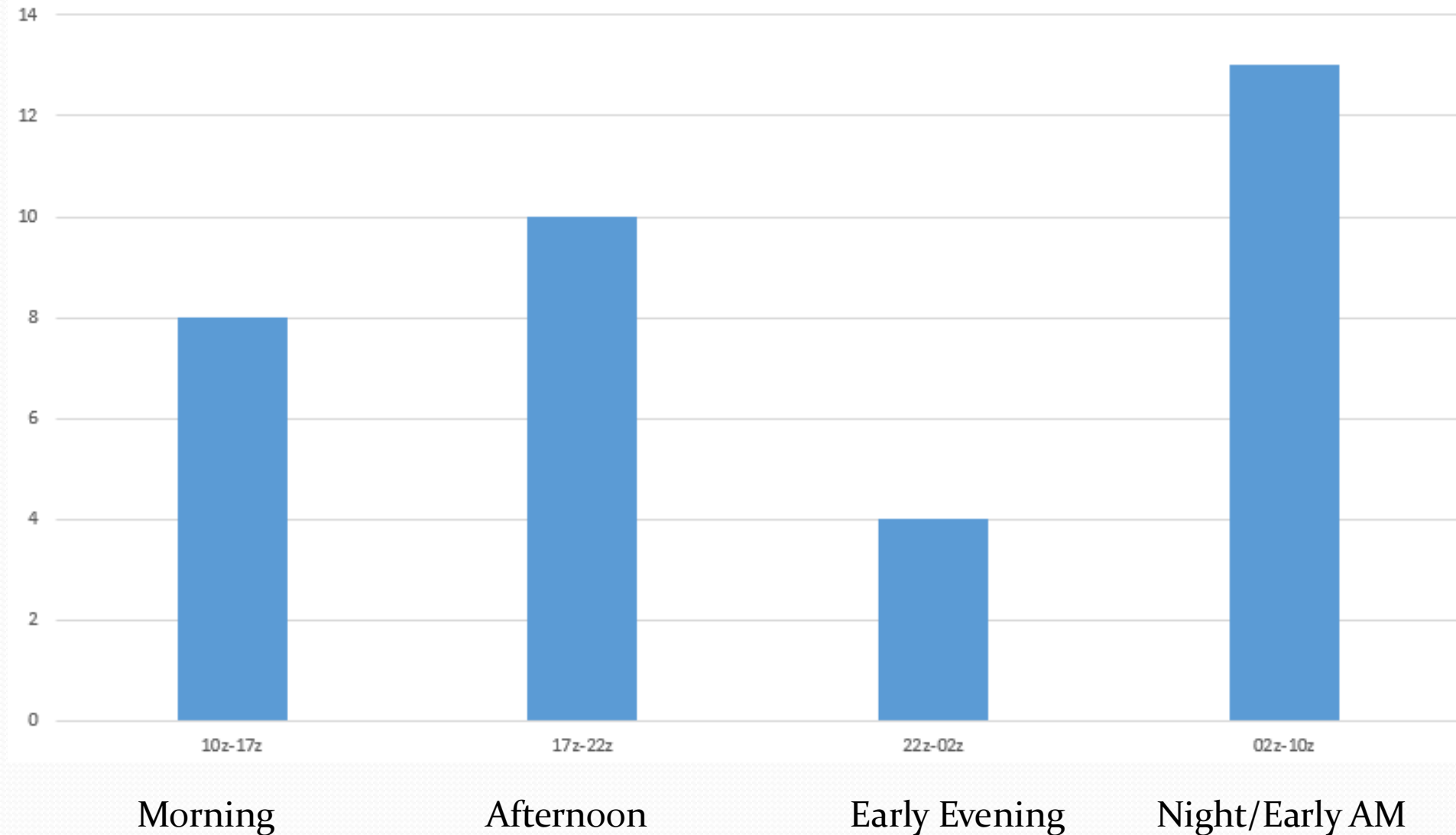
- Length: 30 – 200 miles
- Width: 10 – 30 miles
- Speed: 25 – 35 mph

- Duration: 5 – 40 minutes

Snow Squalls – visibility can drop in < 5 minutes
and return in 5 – 10 minutes.

Typical Characteristics

Time Snow Squall Observed



Snow Squall Types

- David Coe – analyzed the last 10 years of data
- Found 4 types of Snow Squall behavior:
 - Classic: long line moves from NW to SE

Other 3 types: shorter lines

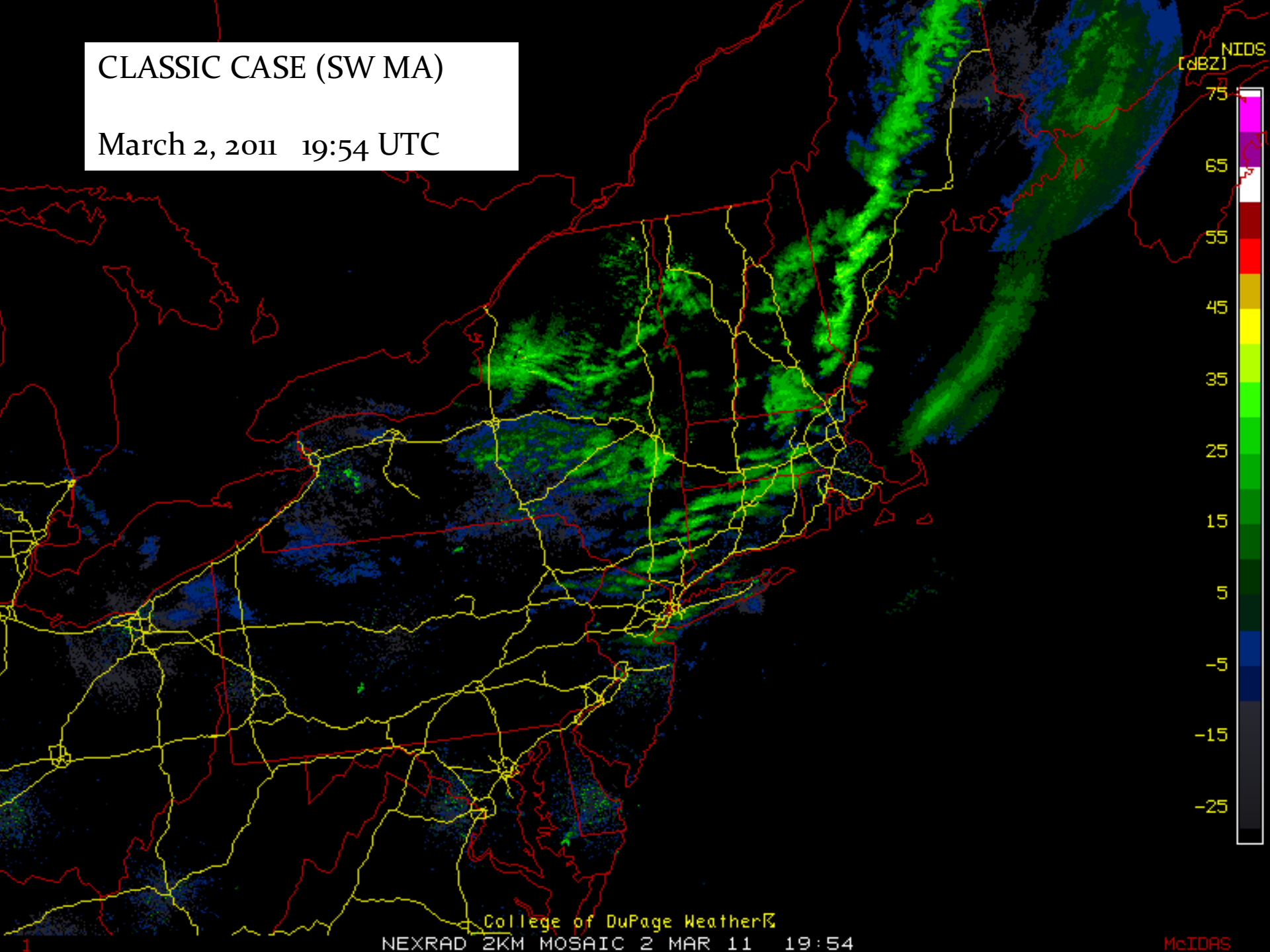
- Northern – line moves from north to south
- New York – line moves more from west to east
- Atlantic – form over ocean, rotate around an offshore low pressure area or around a low to the NW

Snow Squall Examples of Types

- 4 Types:
 - Classic (22 cases): Line moves from Great Lakes, northwestern NE, or upstate NY
 - Northern (6 cases): Line forms in northern NE, moves S
 - New York (2 cases): Line forms in western NY, moves E
 - Atlantic Ocean (5 cases): Convection forms along coast or over the ocean, moves S, or SW, then SE, rotating around an ocean low – or forms south of Long Island and moves NE with mid-level flow.

CLASSIC CASE (SW MA)

March 2, 2011 19:54 UTC



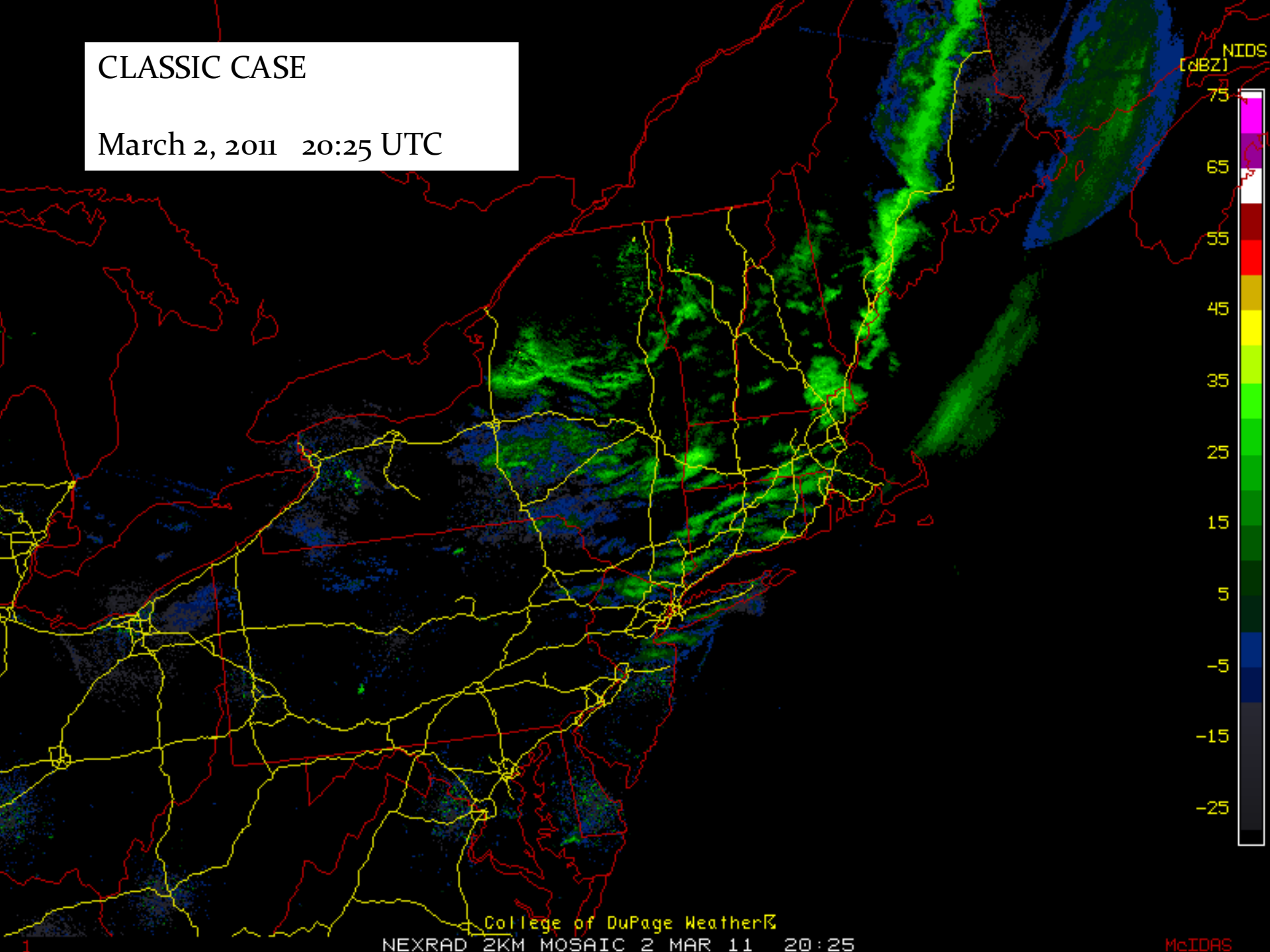
College of DuPage Weather

NEXRAD 2KM MOSAIC 2 MAR 11 19:54

McIDAS

CLASSIC CASE

March 2, 2011 20:25 UTC

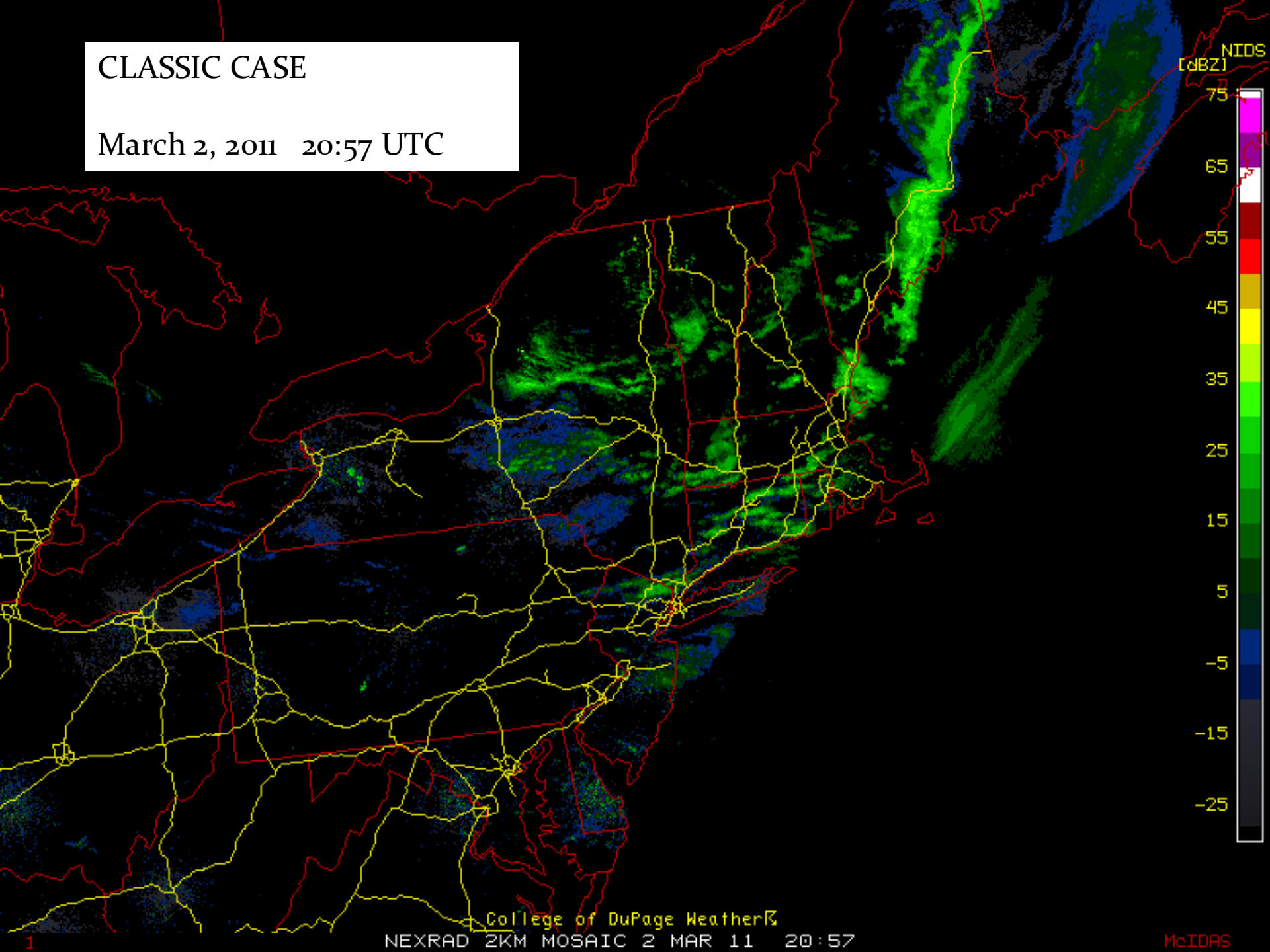


College of DuPage Weather

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McIDAS

CLASSIC CASE
March 2, 2011 20:57 UTC



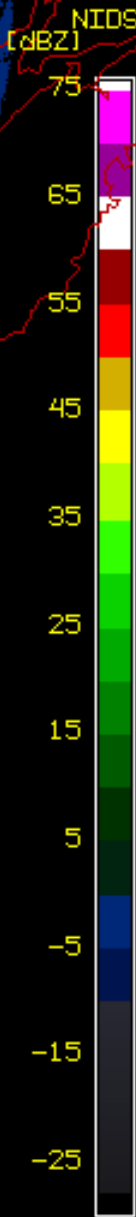
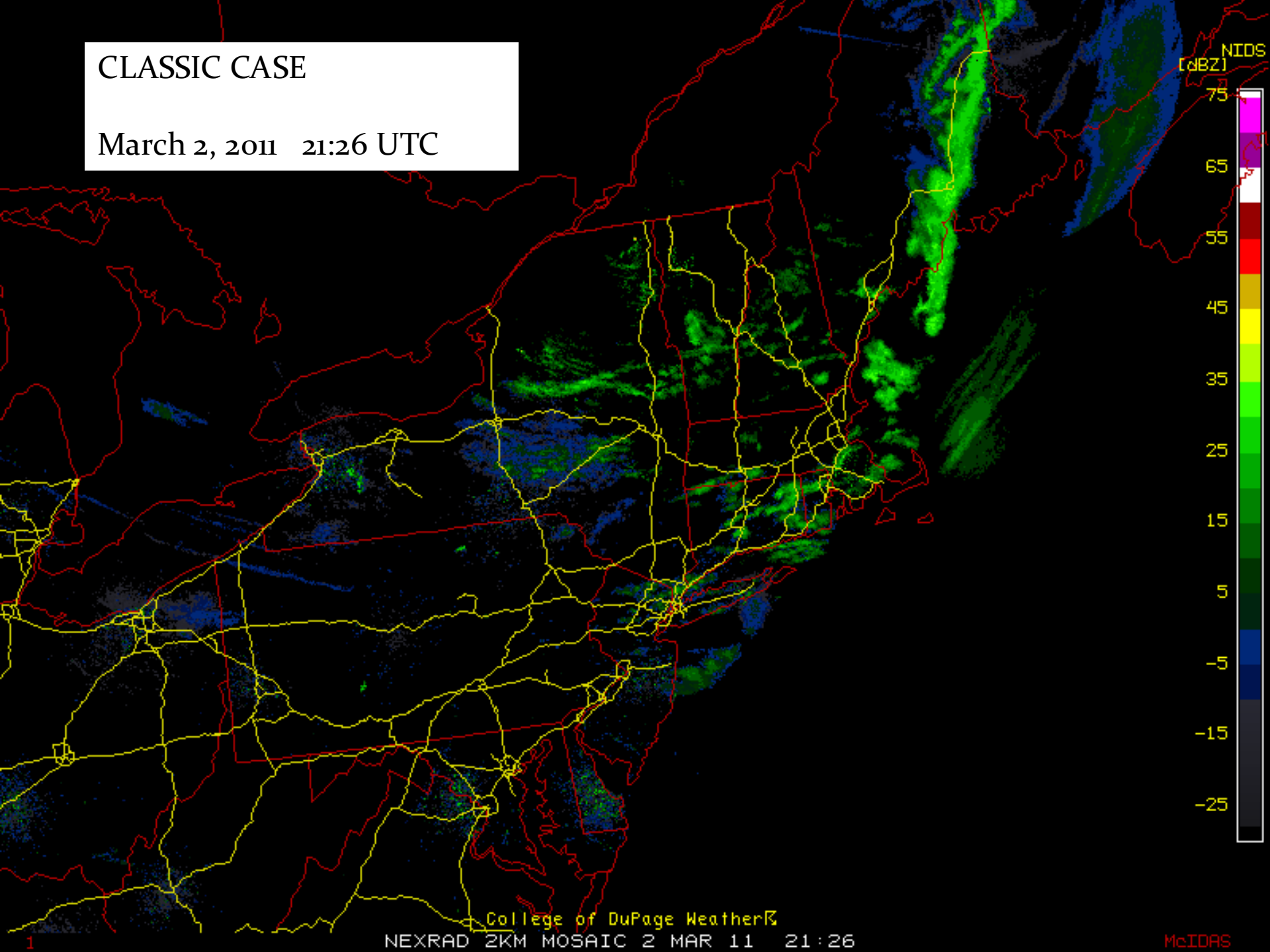
College of DuPage Weather

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McIDAS

CLASSIC CASE

March 2, 2011 21:26 UTC



College of DuPage Weather

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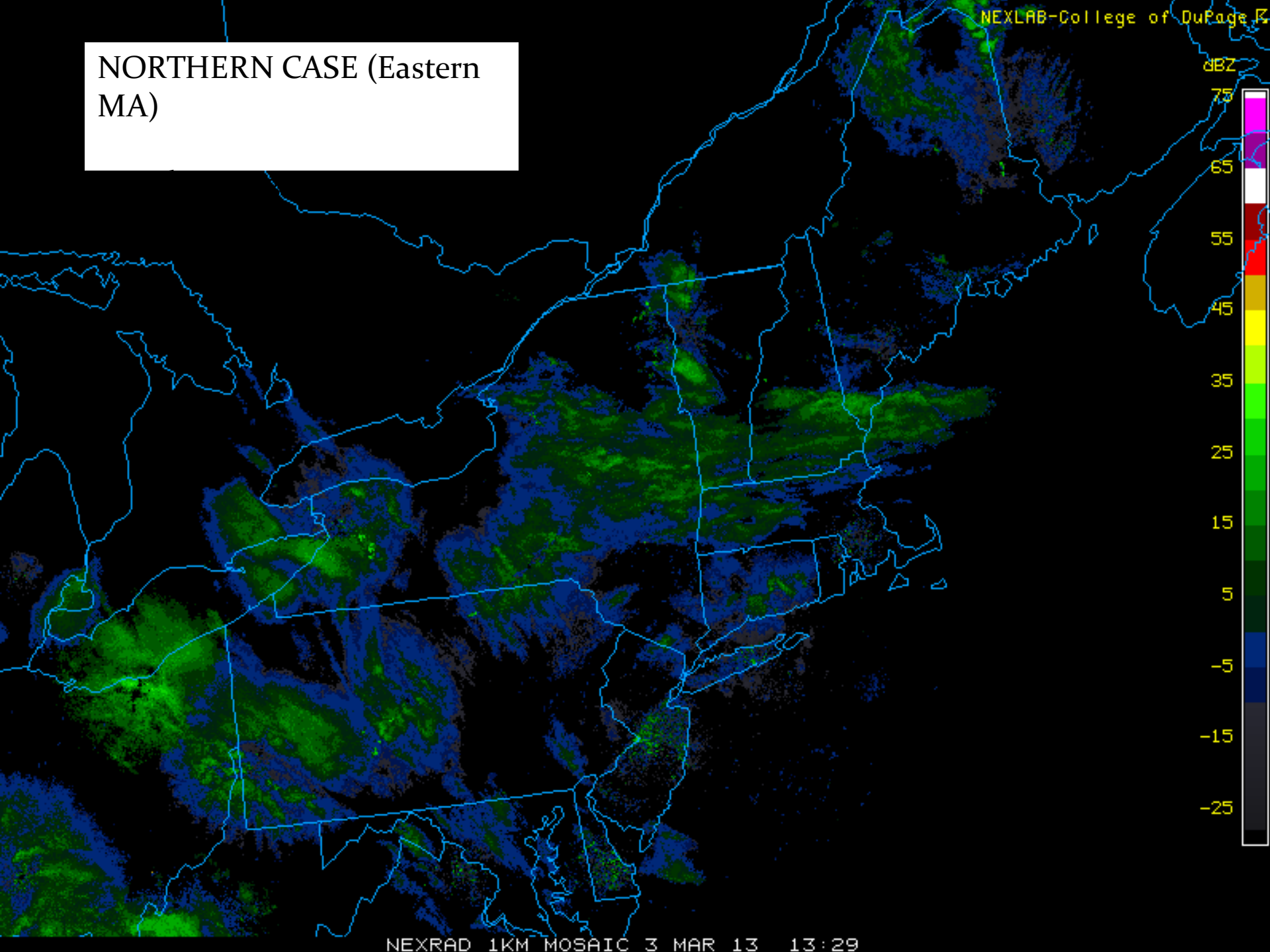
McIDAS

Snow Squall Examples of Types

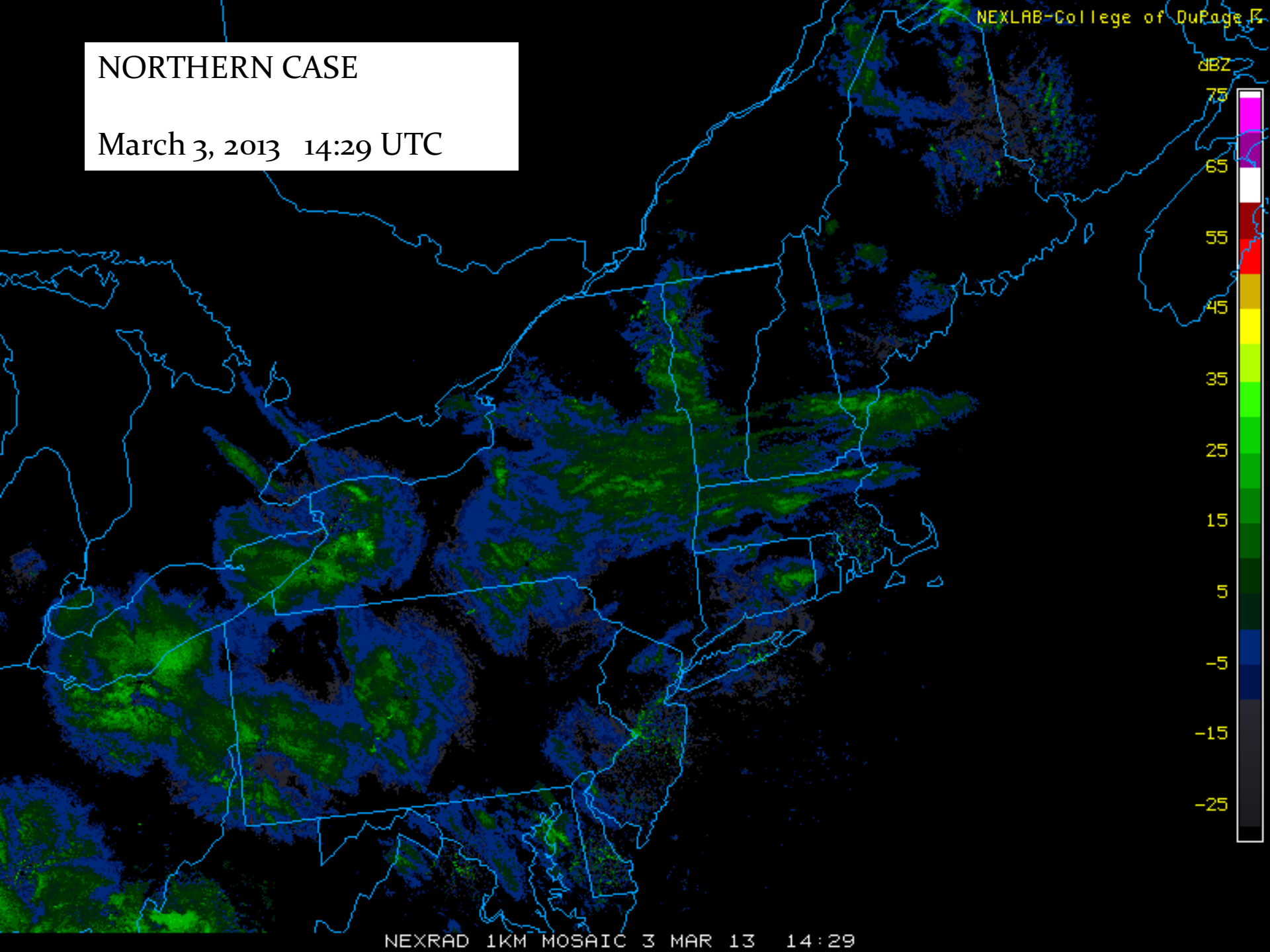
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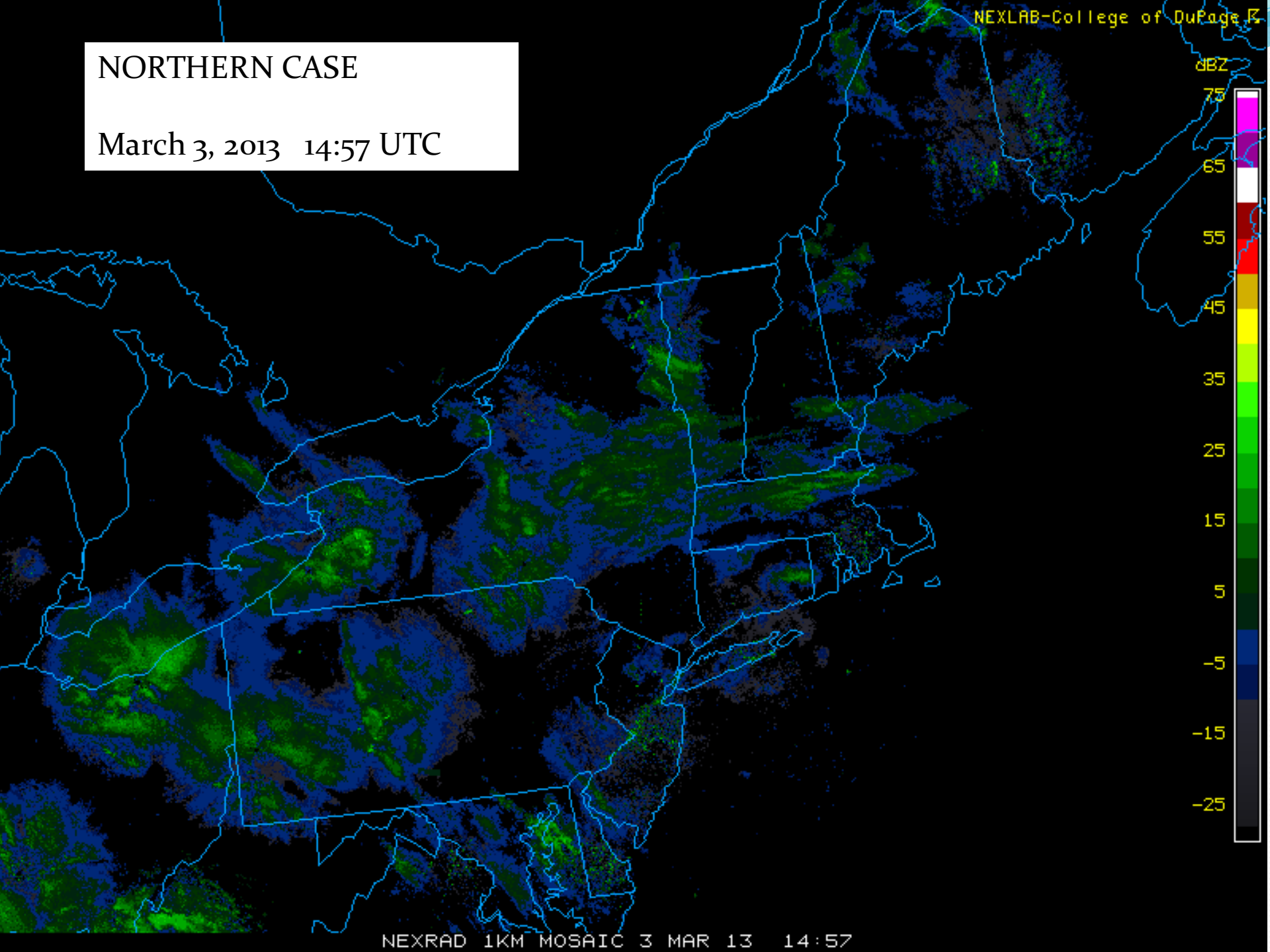
NORTHERN CASE (Eastern MA)



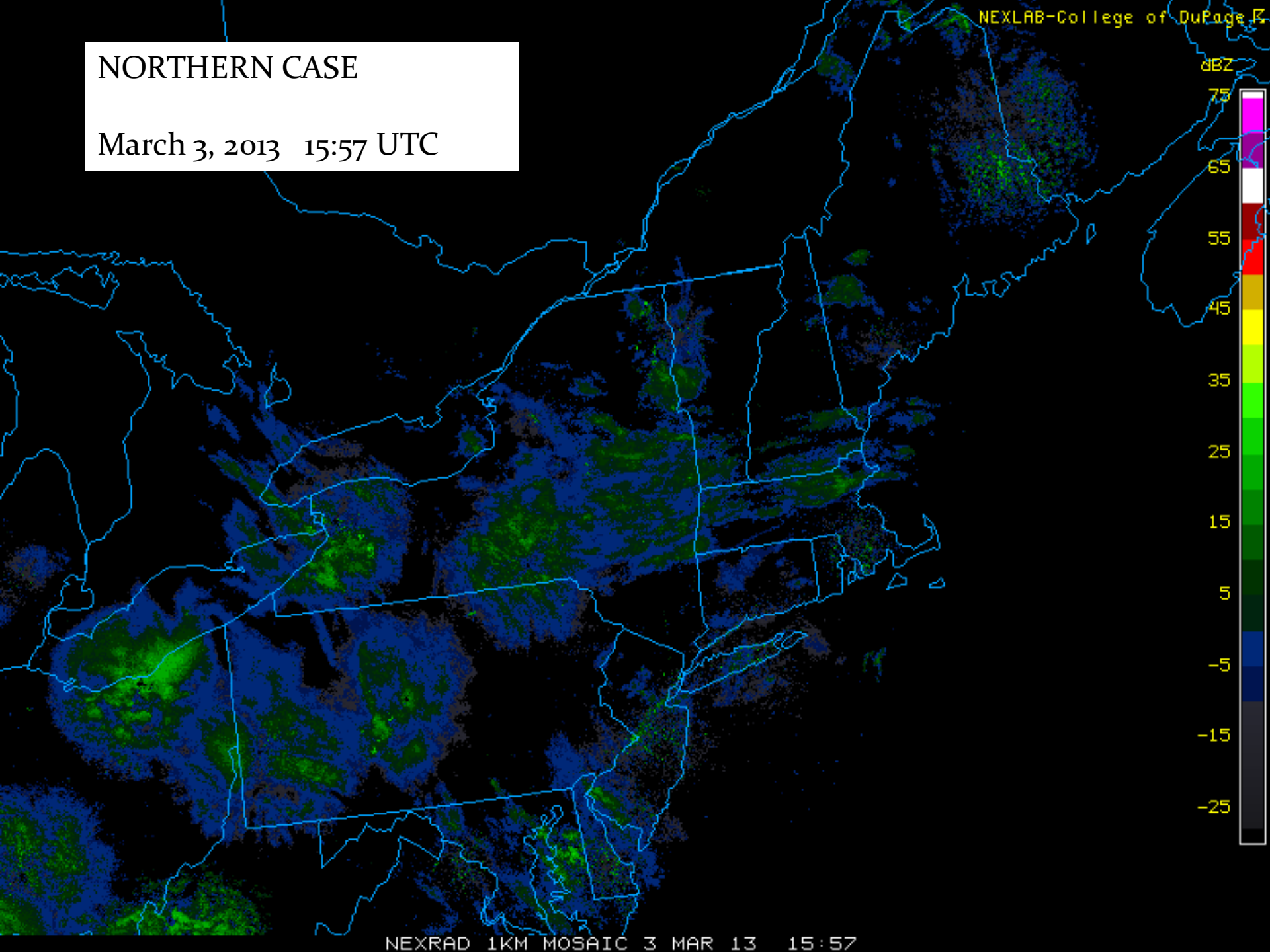
NORTHERN CASE
March 3, 2013 14:29 UTC



NORTHERN CASE
March 3, 2013 14:57 UTC



NORTHERN CASE
March 3, 2013 15:57 UTC

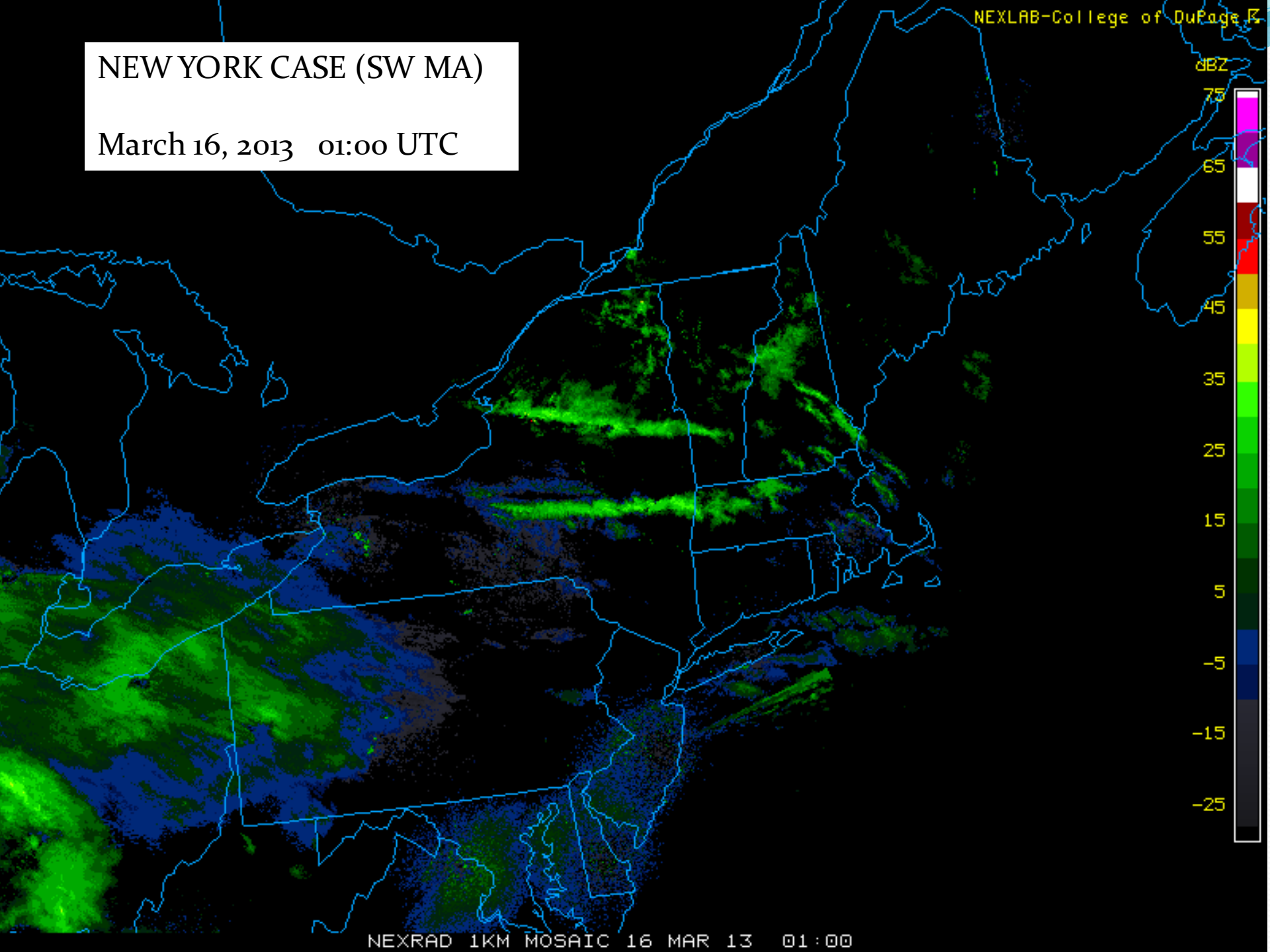


Snow Squall Examples of Types

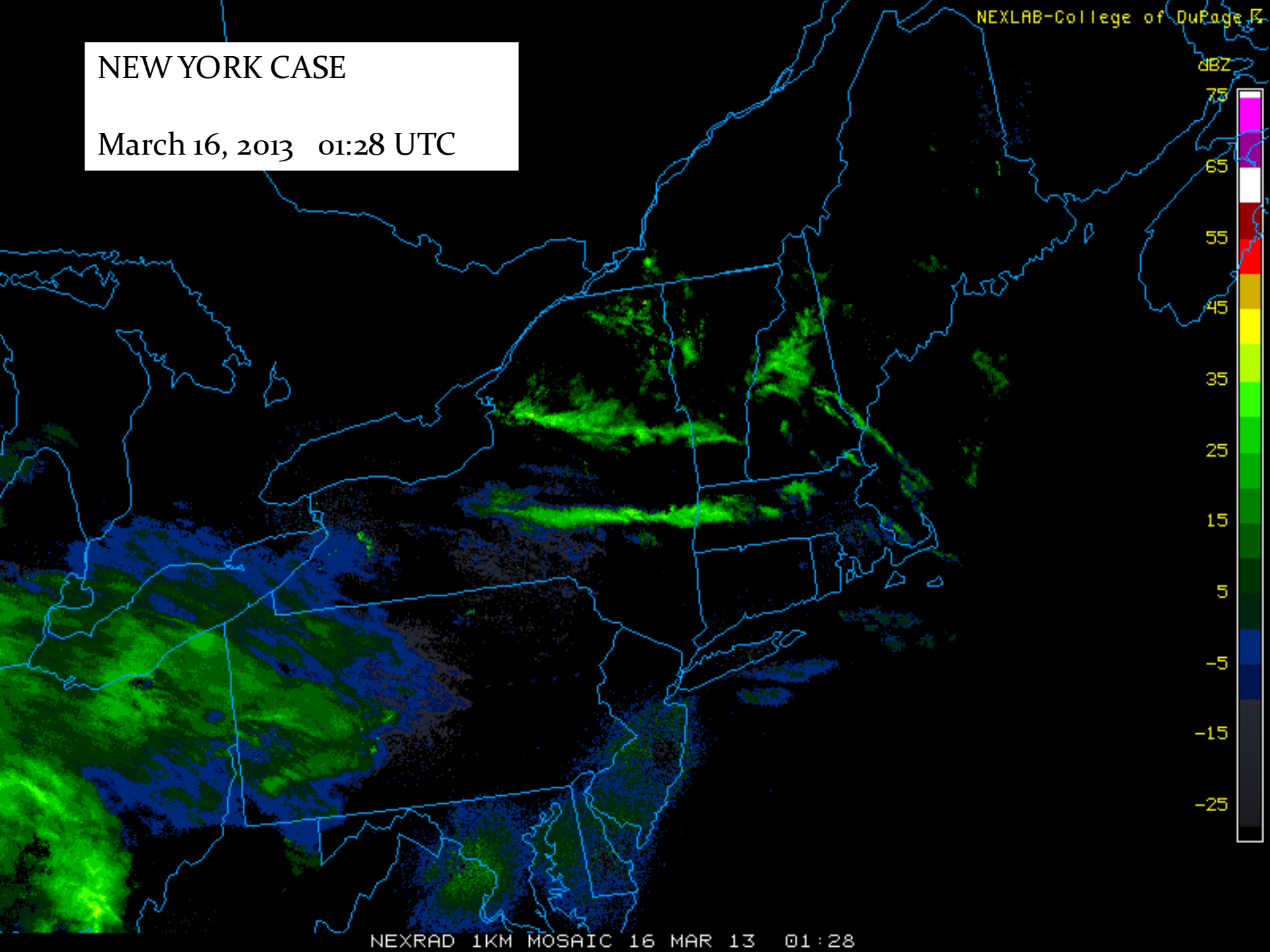
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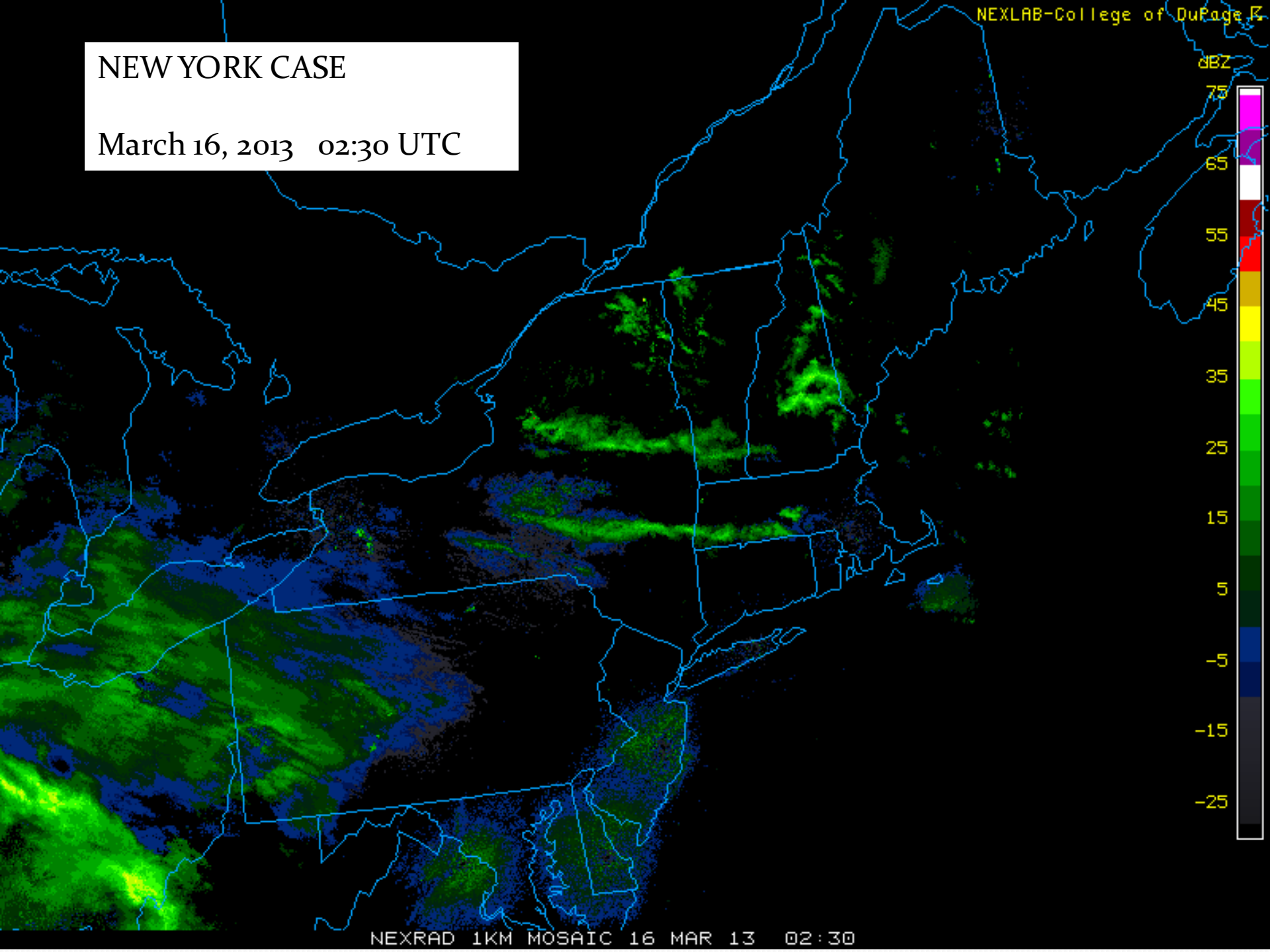
NEW YORK CASE (SW MA)
March 16, 2013 01:00 UTC



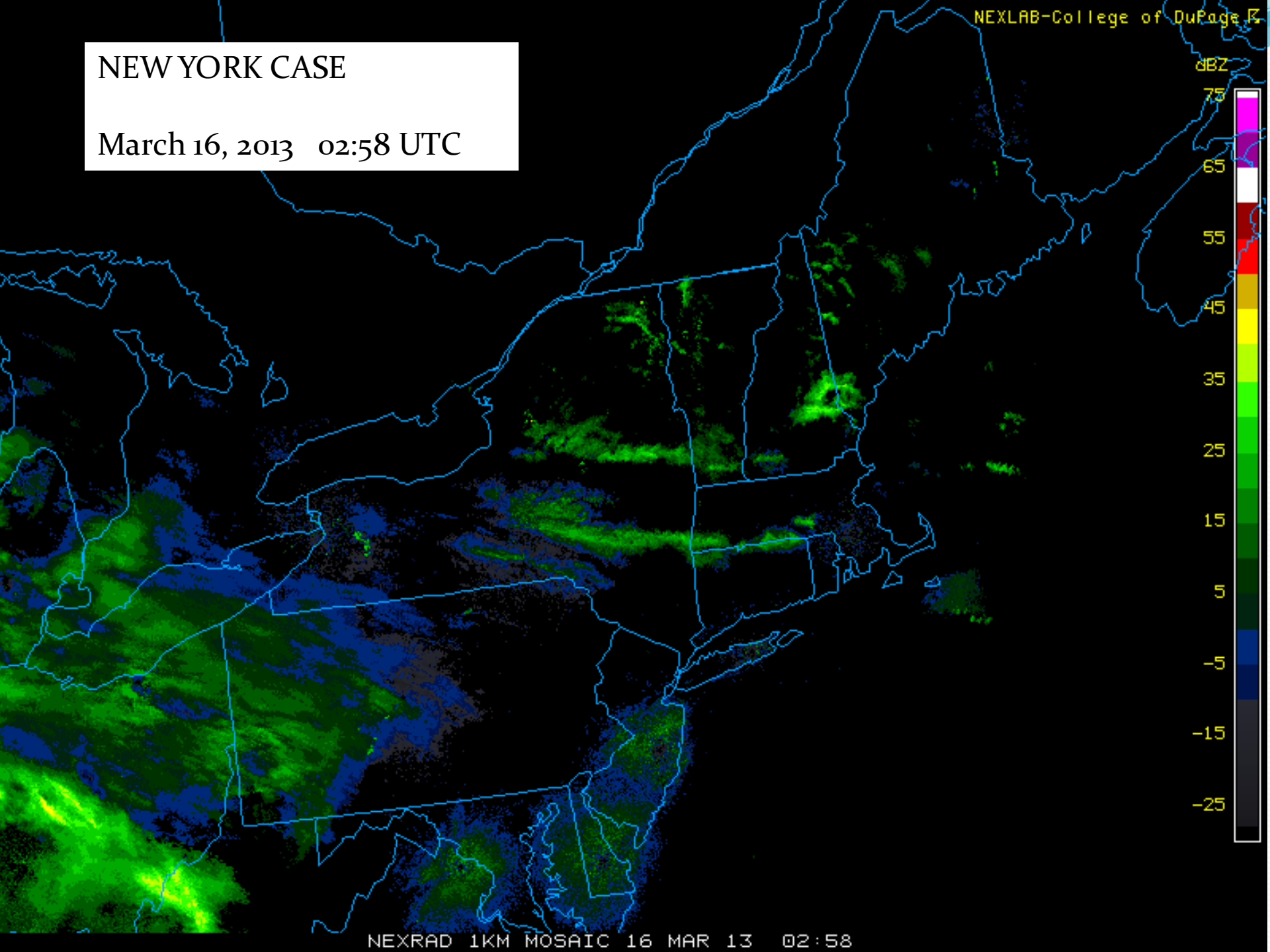
NEW YORK CASE
March 16, 2013 01:28 UTC



NEW YORK CASE
March 16, 2013 02:30 UTC



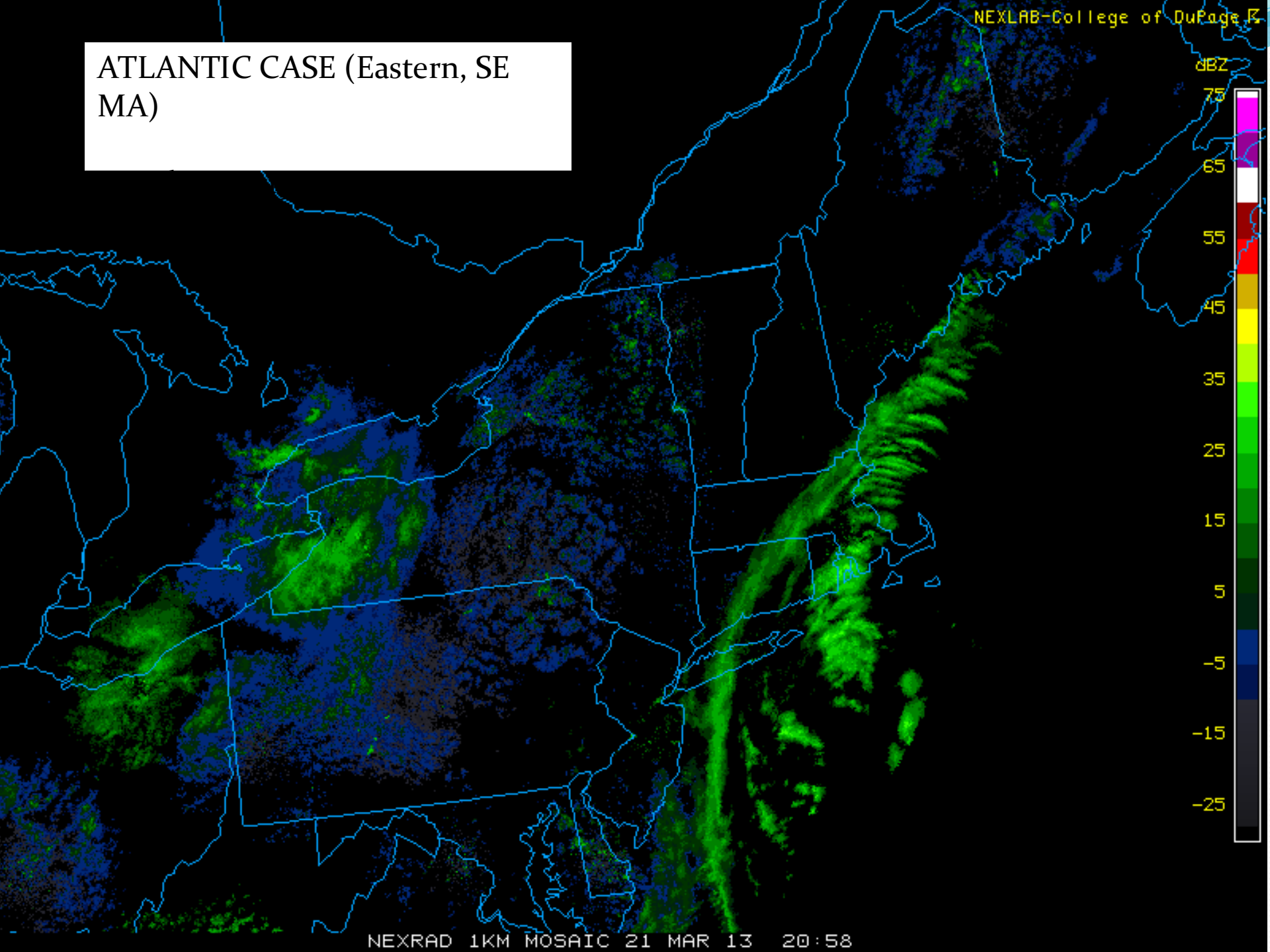
NEW YORK CASE
March 16, 2013 02:58 UTC



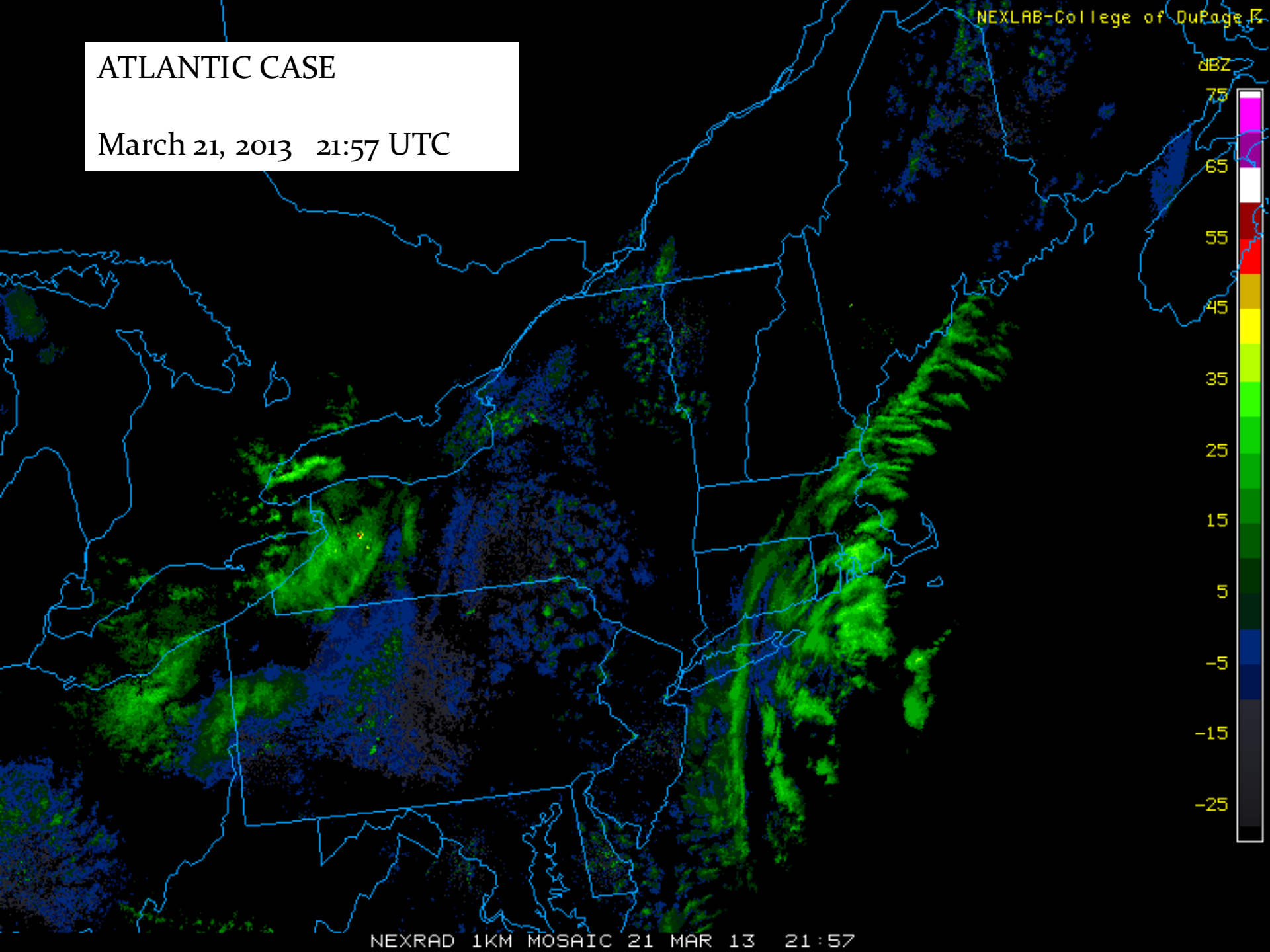
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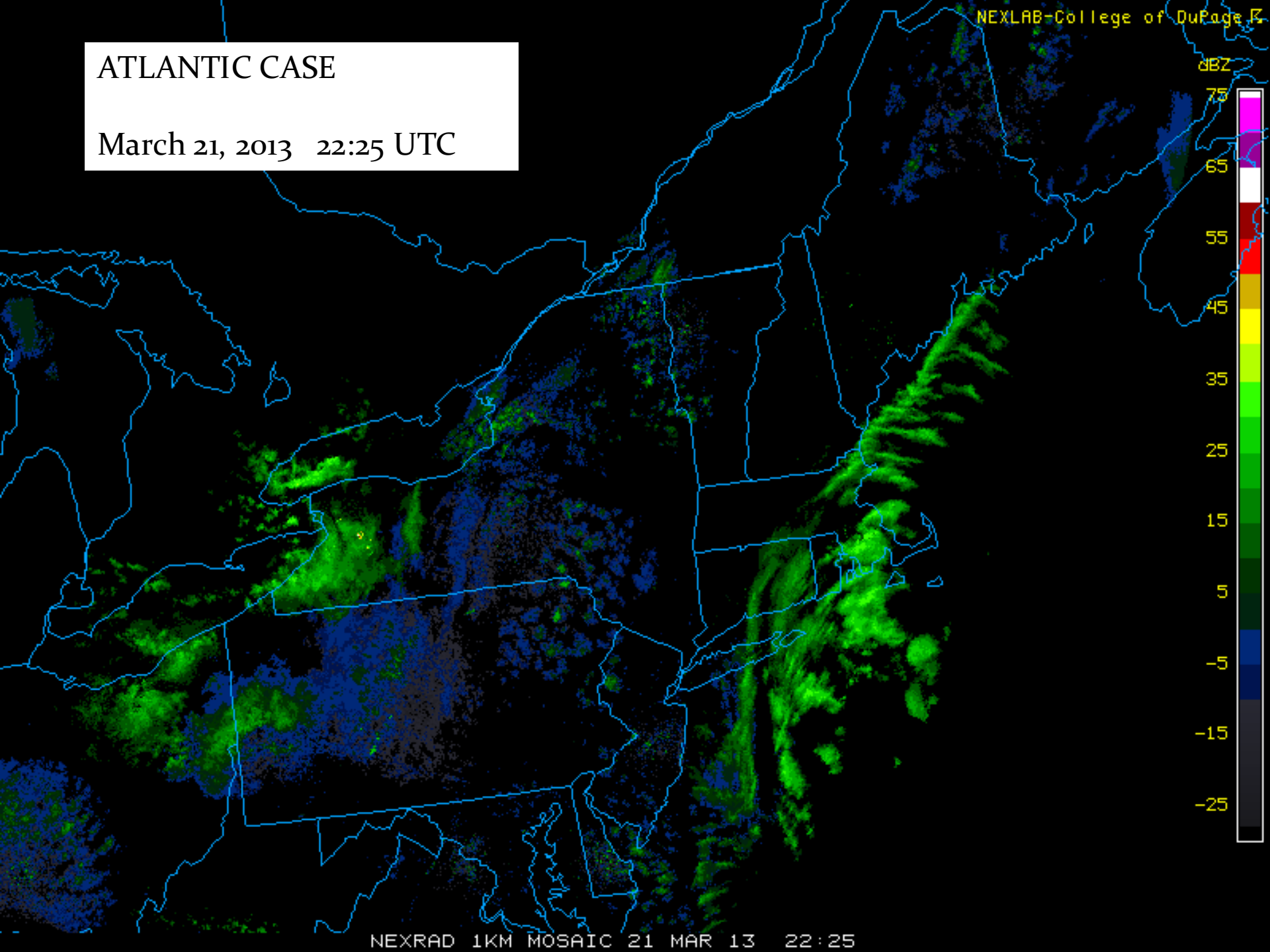
ATLANTIC CASE (Eastern, SE MA)



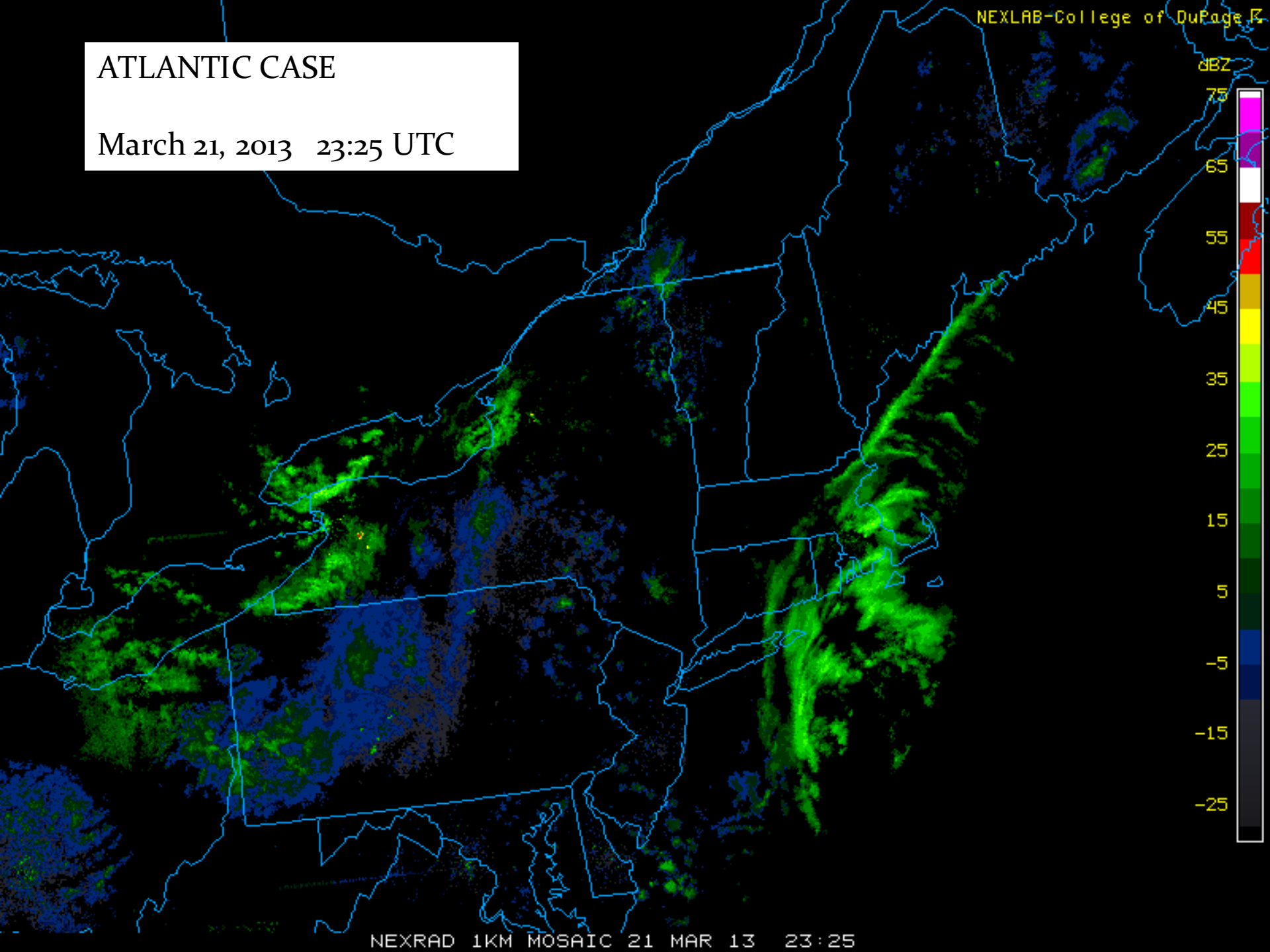
ATLANTIC CASE
March 21, 2013 21:57 UTC



ATLANTIC CASE
March 21, 2013 22:25 UTC



ATLANTIC CASE
March 21, 2013 23:25 UTC

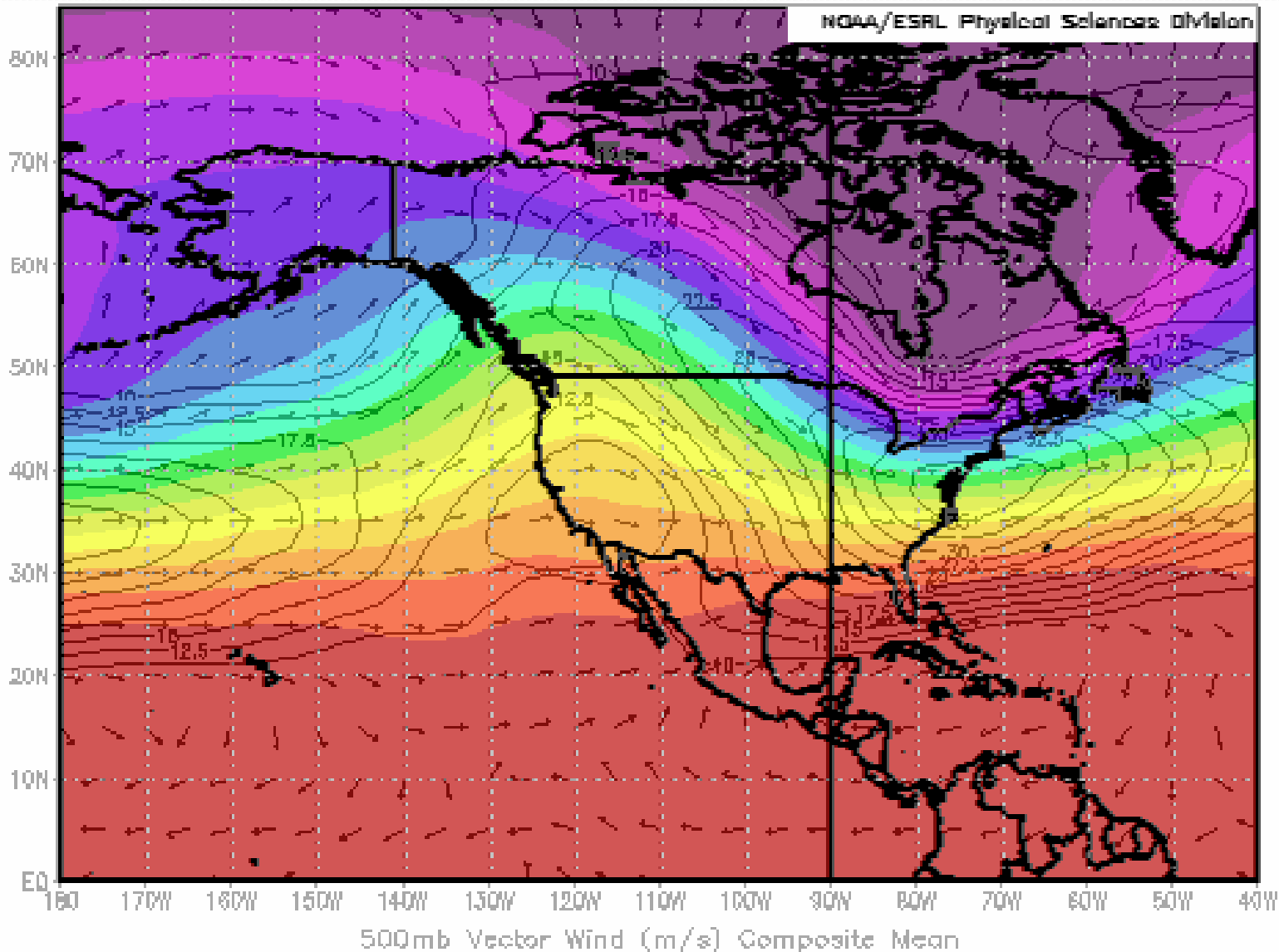


Snow Squall Climatology

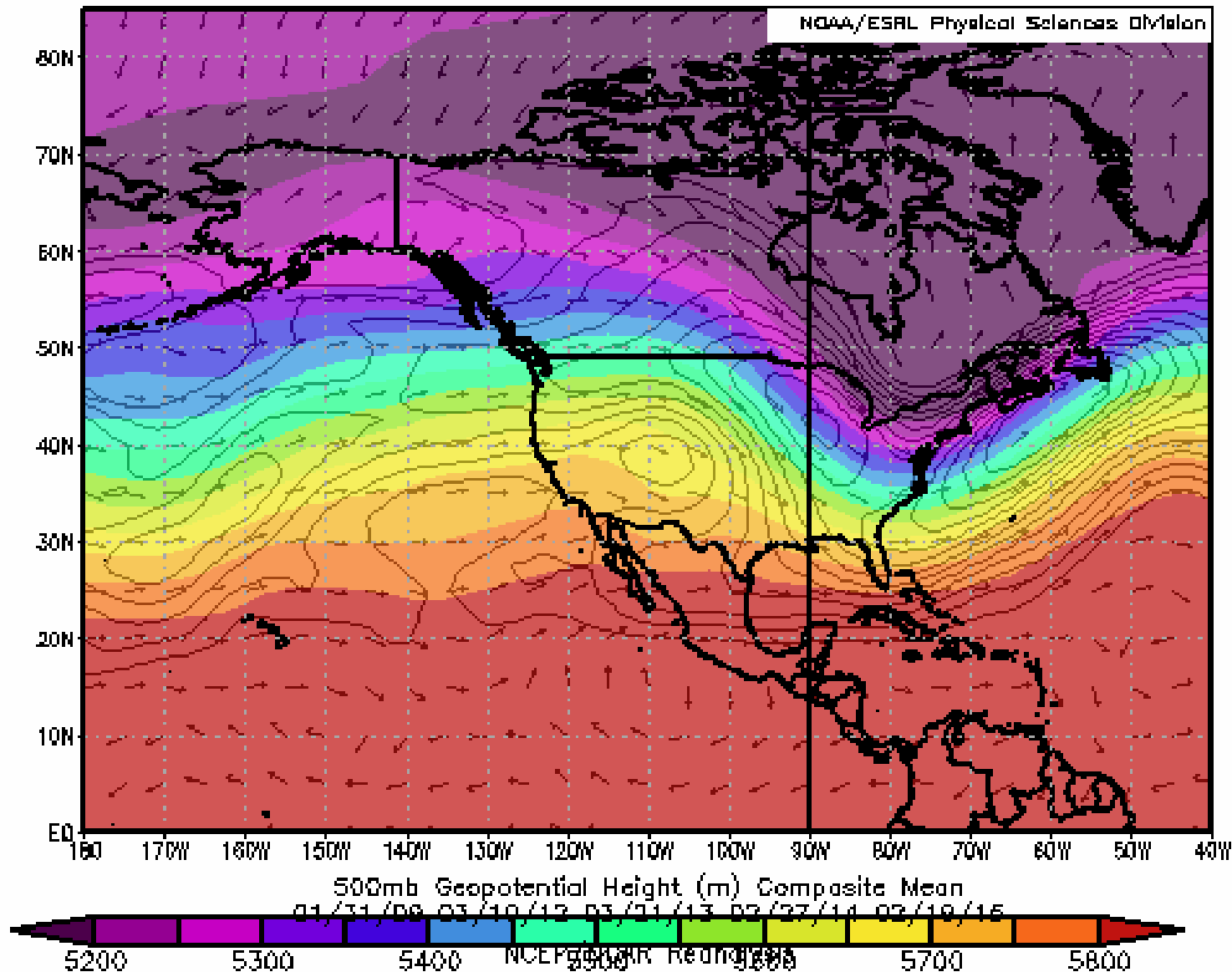
Upper-Level Jet Stream

- All 4 types have a trough in the vicinity of NE.
- Classic and Atlantic – trough axis west of NE
- Northern - closed low north of ME, trough axis east of NE
- New York – slight trough west of NE

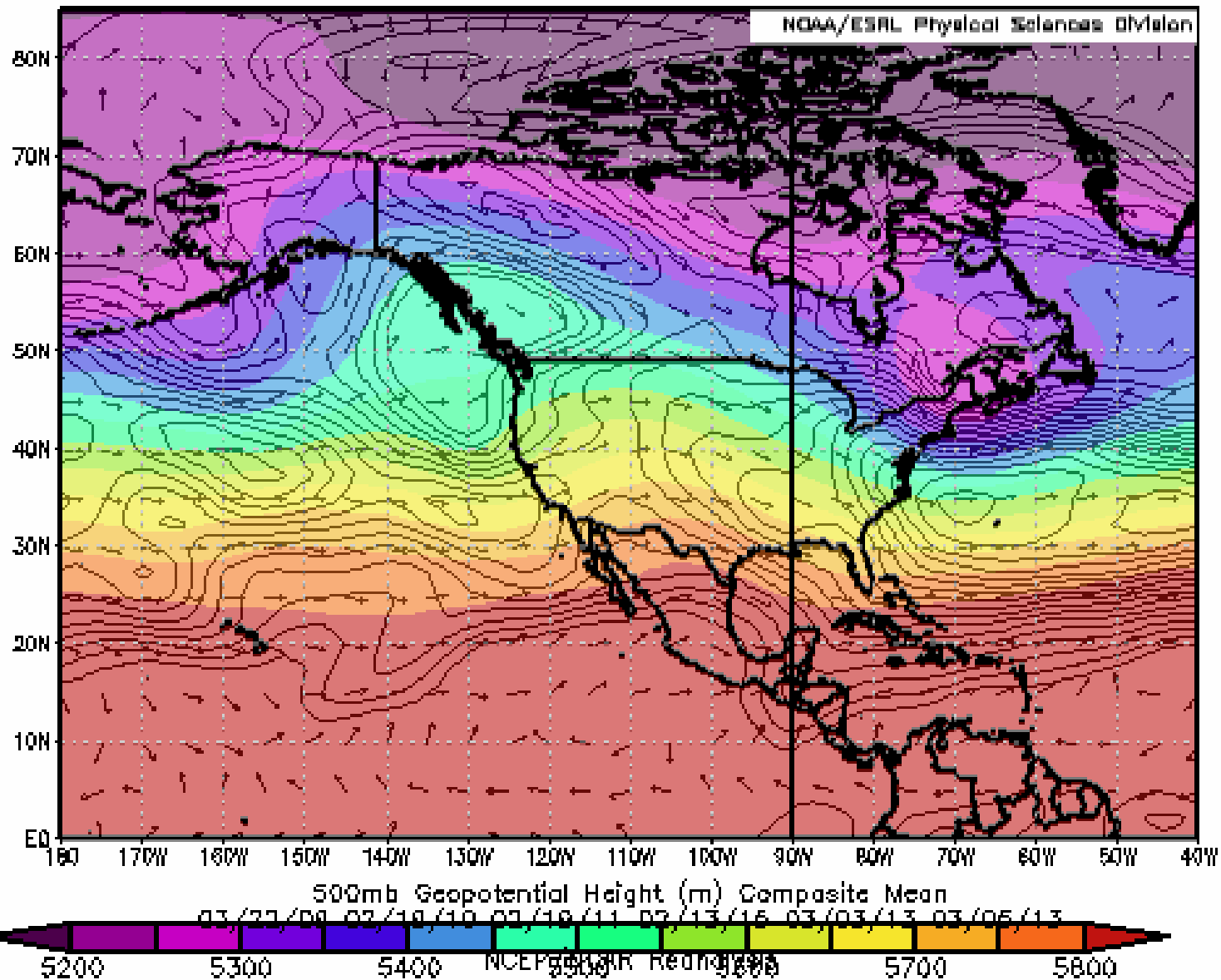
Classic 500 hPa



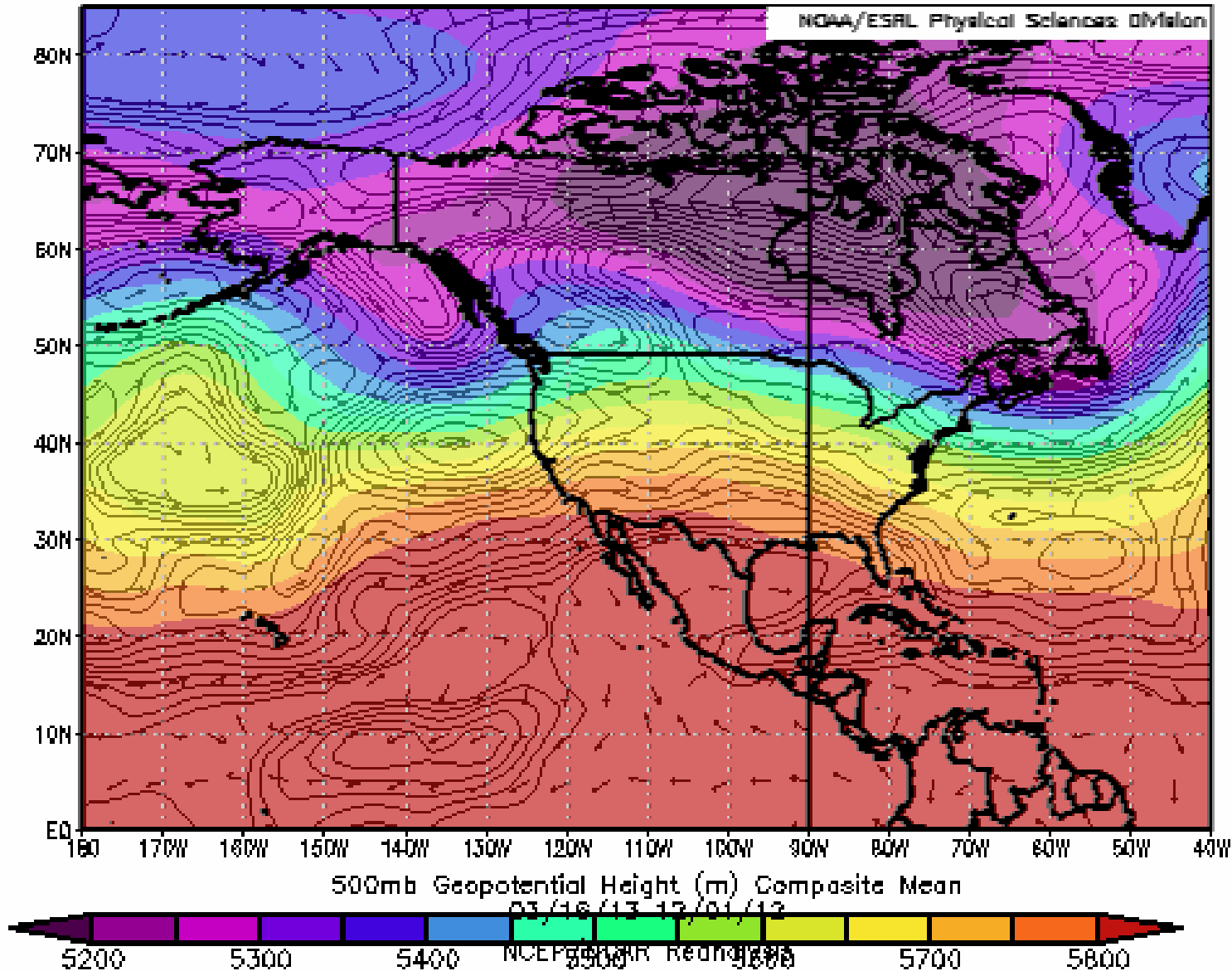
Atlantic 500 hPa



Northern 500 hPa



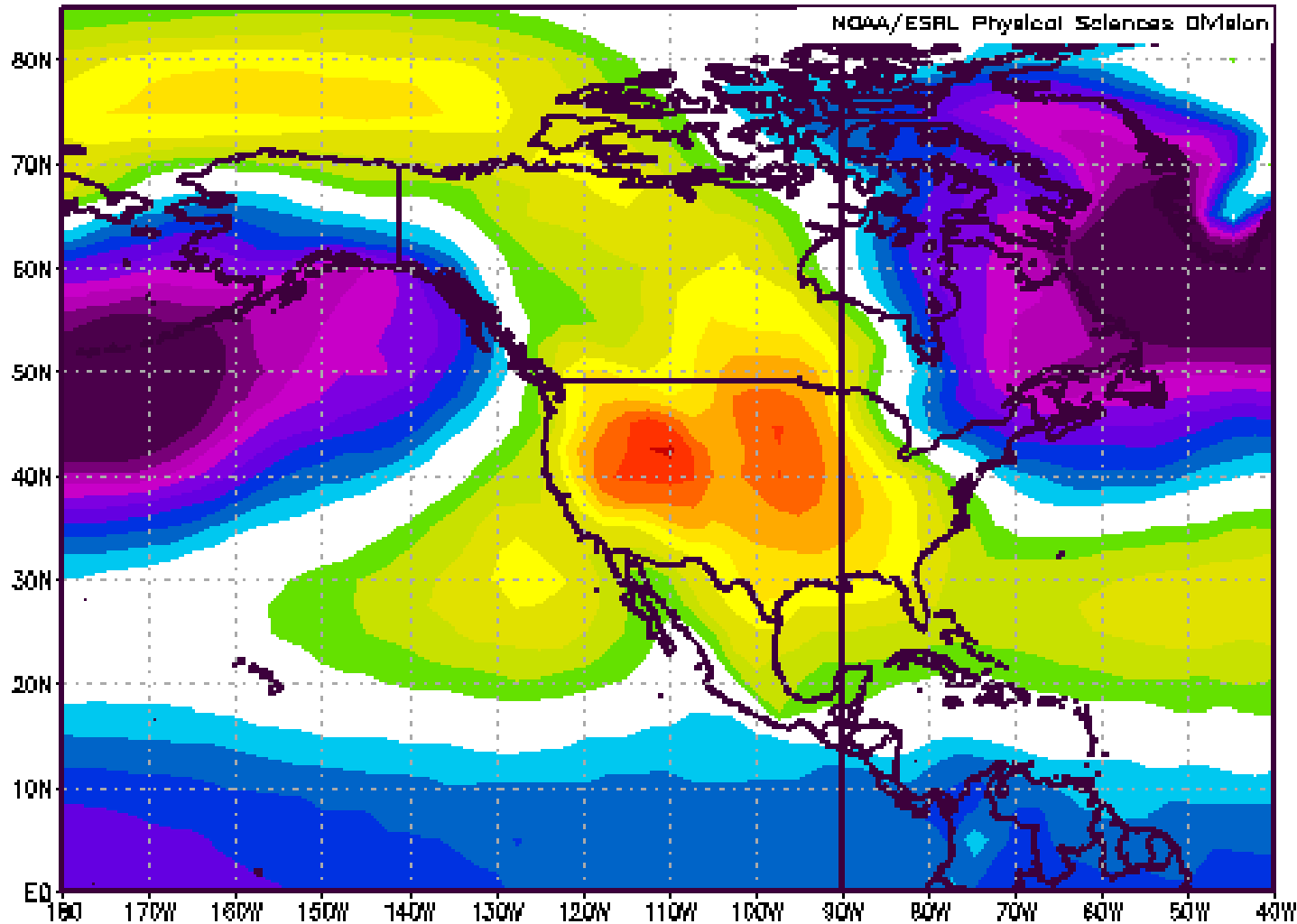
New York 500 hPa



Snow Squall Climatology – Surface

- Classic – High over Midwest, low northeast of Maine
- Atlantic – High over Midwest, low east of NE
- Northern – High NW of Great Lakes, low northeast of Maine
- New York – High over Midwest, low over the Great Lakes

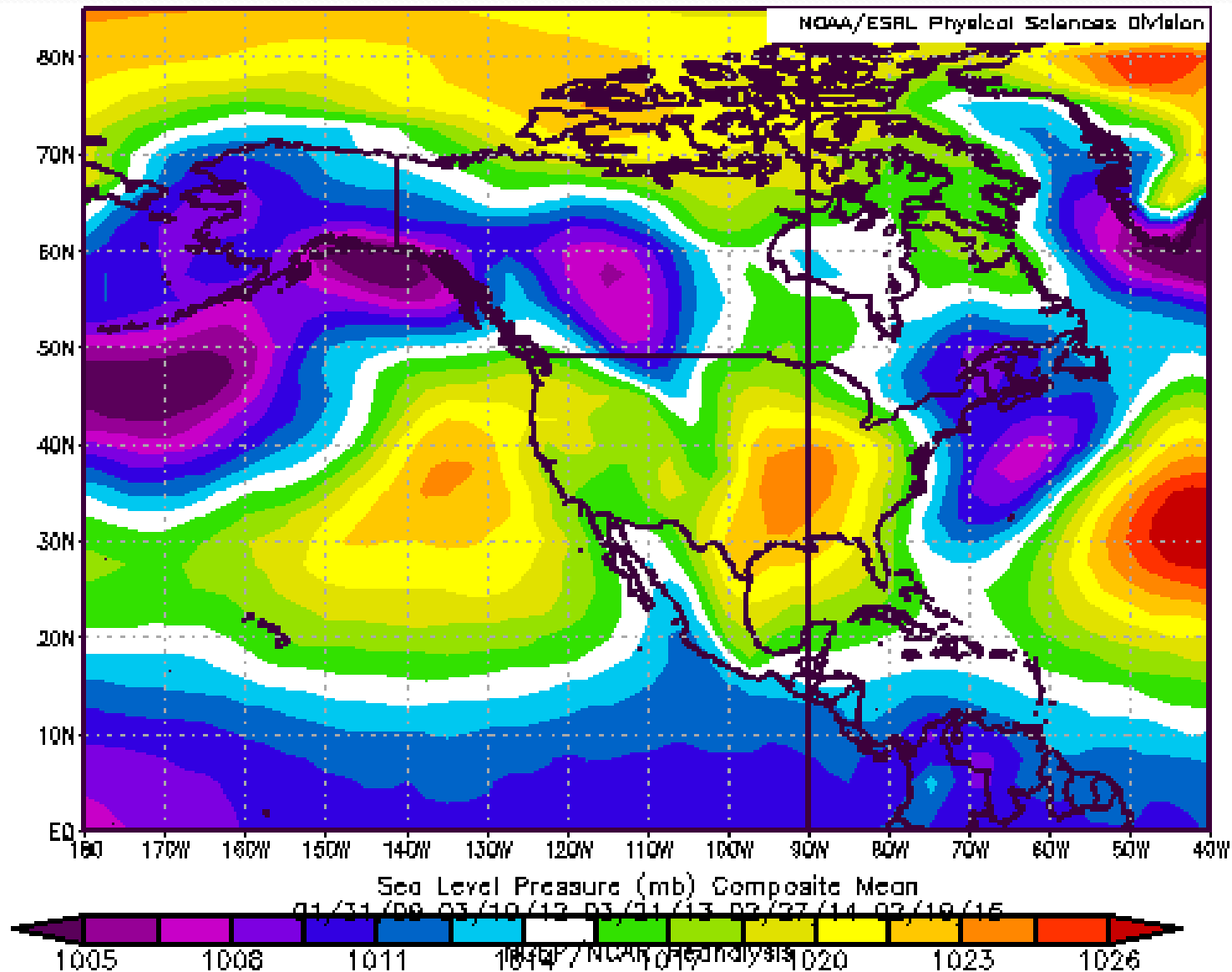
Classic MSLP



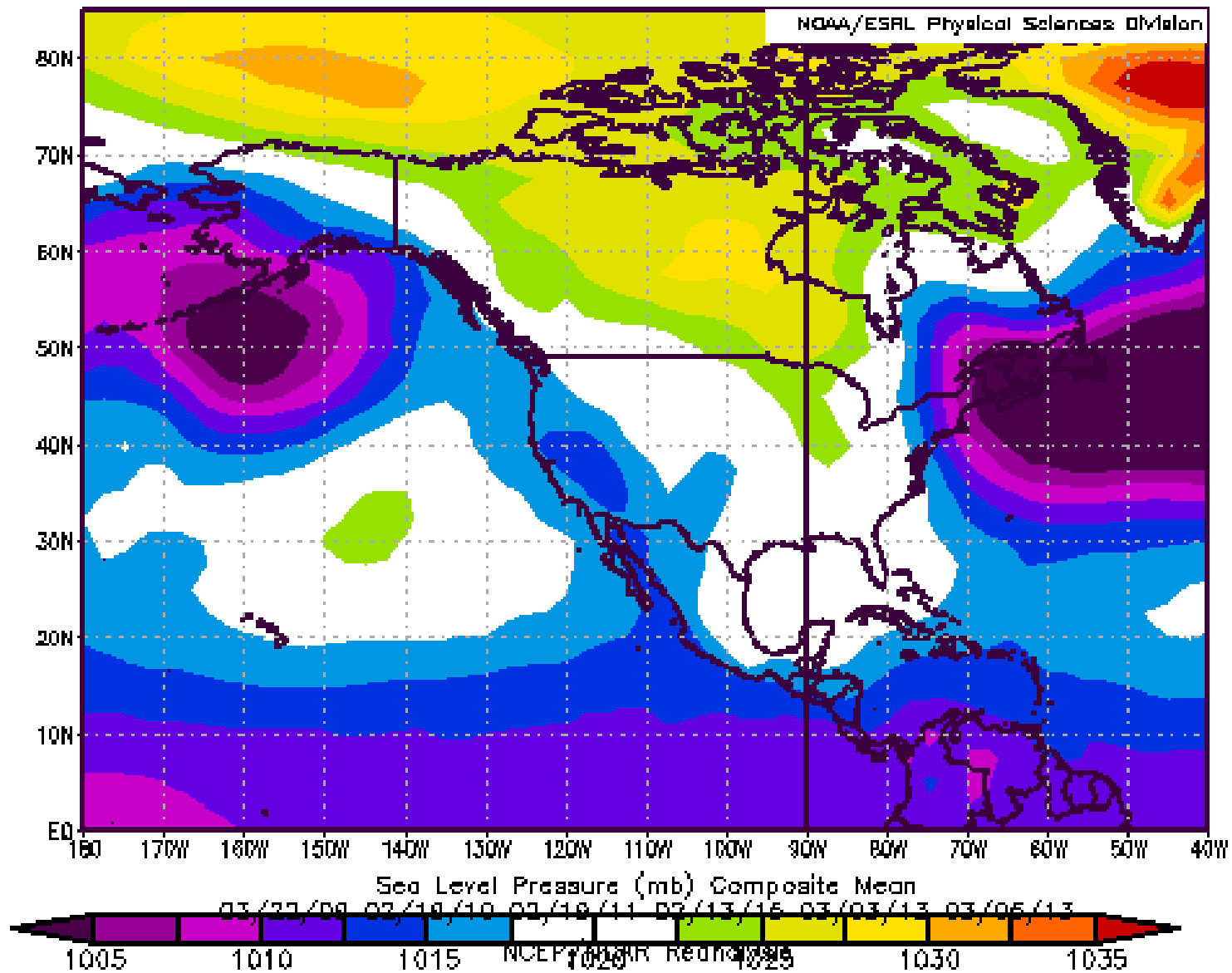
/02 01/13/03 07/08/03 12/09/03 01/08/04 01/13/04 01/17/04 12/17/04 02/08/05 03/15/05 01/24/06

1994/NCAR/1750ndh/920

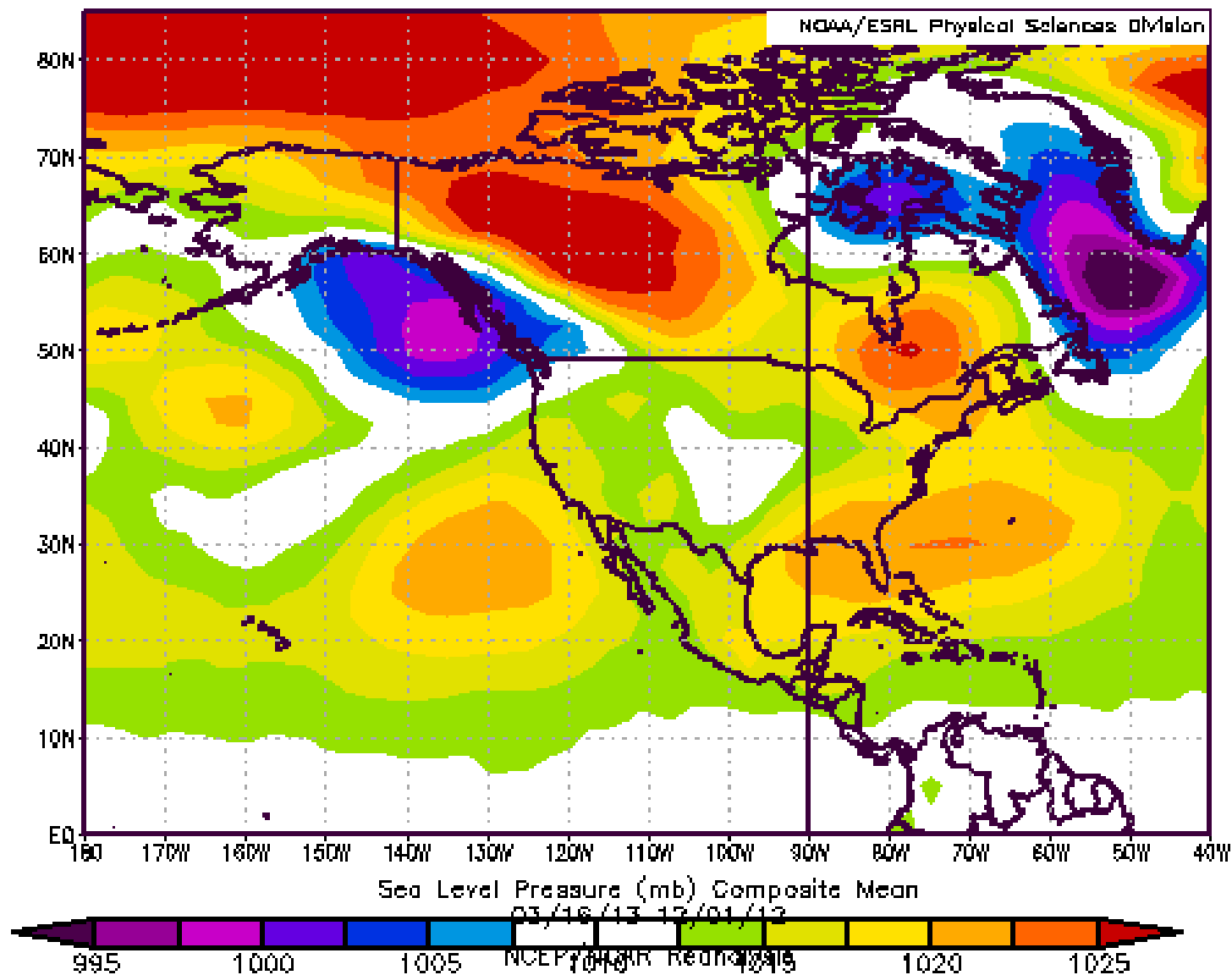
Atlantic MSLP



Northern MSLP



New York MSLP



Snow Squall Climatology

- Years for Types:
- Northern: 2009 – 2015
- New York: 2012, 2013
- Atlantic: 2009 – 2015
- Classic: 1997 – 2016
 - 15 between 1997 and 2006
 - 3 in 2007
 - 1 in 2008
 - 1 in 2011
 - 1 in 2013
 - 1 in 2016

Snow Squall Climatology

- Why the Shift?
 - Only Classic: 1997 – 2008
 - Mixture of 4 types: 2009 – present
 - 3 Classic, 6 northern, 2 New York, 5 Atlantic
- Changing Climate?
- Normal Decadal Oscillations?

Final Thoughts

- Snow Squalls are intense, convective snow events
- They occur in Southern New England in the months of December – March
- Four types – three of which have appeared only in the last 8 years
- Shift in types may be related to climate change or natural decadal oscillations?

Future Work

- Extend the climatology to the whole US, starting with the East Coast states

Future Work

- Extend the climatology to the whole US, starting with the East Coast states
- Continue to investigate connection between Climate Change and Snow Squall Patterns
- Thank you! Any Questions?

References

- Banacos , Loconto, and Devoir (NWS) – 2014
 - 36 cases affecting Burlington and Montpelier, VT and Massena, NY
- Milrad, Gyakum, Lombardo, and Atallah – 2014
 - 2 “Snow Burst” events
- Milrad, Gyakum, Atallah, and Smith – 2010
 - One case