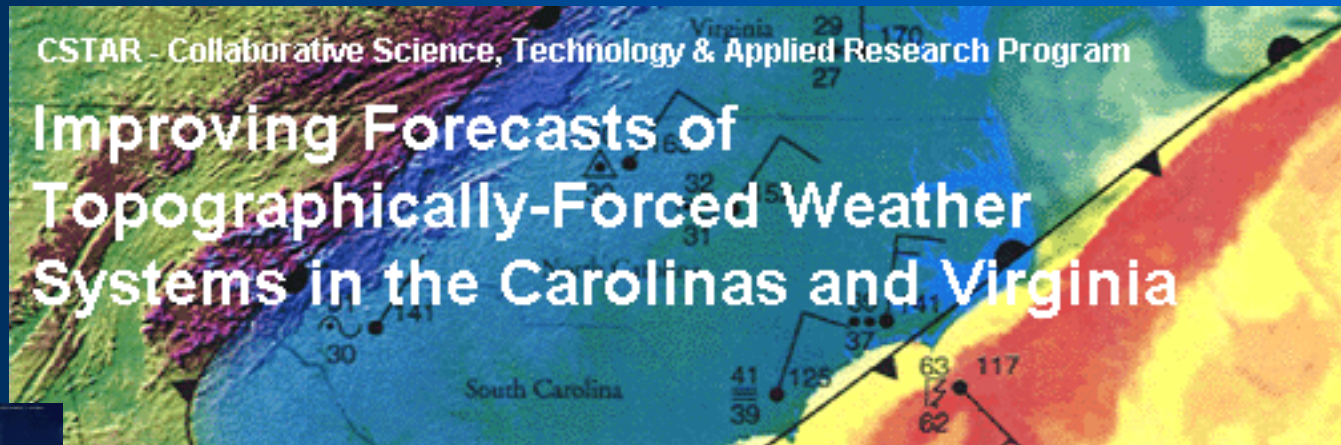


Collaboration & Research Success: NOAA/National Weather Service and North Carolina State University



Presented by:
Gail Hartfield
NOAA/NWS Raleigh, NC

NWS-NCSU Collaborations: A long and storied road

- 1970s:
 - John McClain (NWS) & Walter Saucier (NCSU)
 - Student internships
 - American Meteorological Society meetings, NCSU seminars
 - Forecast aids: winter precipitation type study, topography of flash flood

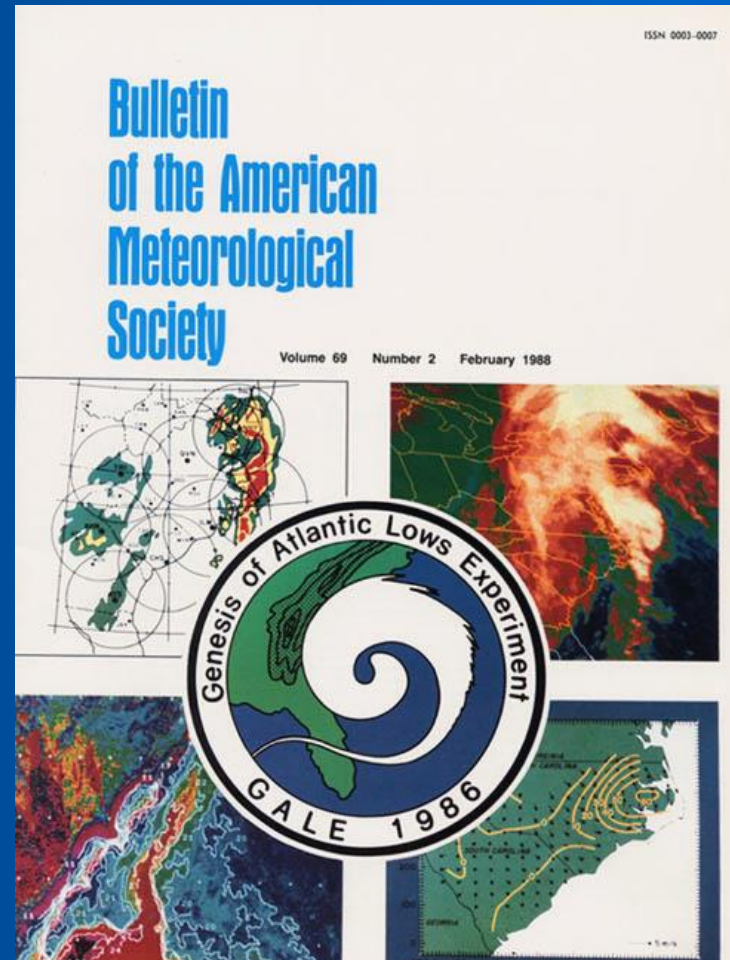
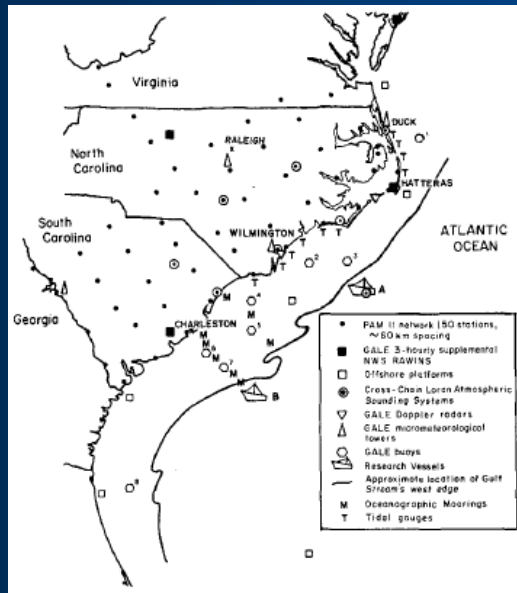


1Lt Walter J. Saucier
18th Weather Squadron
Commander



NWS-NCSU Collaborations: A long and storied road

- 1980s:
 - The GALE Project, studying the development of Atlantic storms



NWS-NCSU Collaborations: A long and storied road

- 1990s:
 - The Southeast Consortium on Severe Thunderstorms and Tornadoes
 - Included intensive study of the Nov. 28, 1988 Raleigh F4 tornado →
 - Paradigm for tornado outbreaks in the Carolinas/mid-Atlantic was developed
 - Conceptual models adopted by operational forecasters; computer-based tools for detection of tornado outbreaks later created

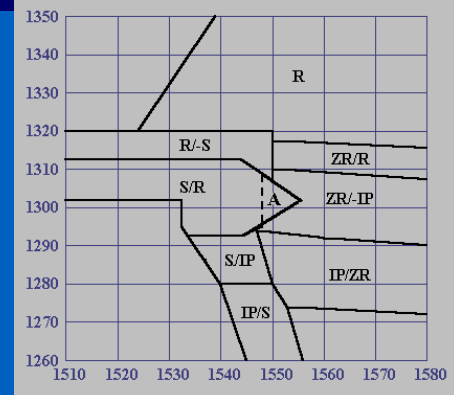
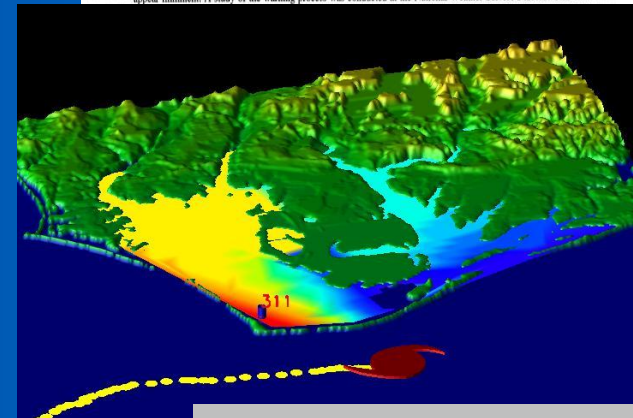
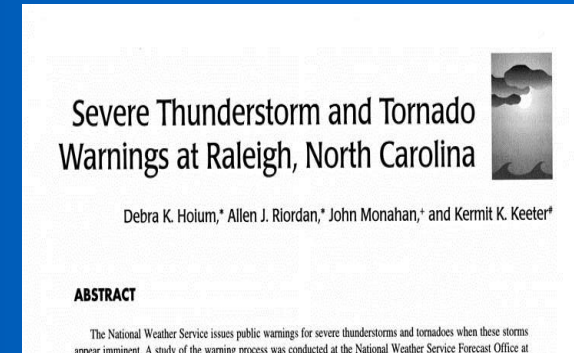


Photos courtesy of WRAL-TV



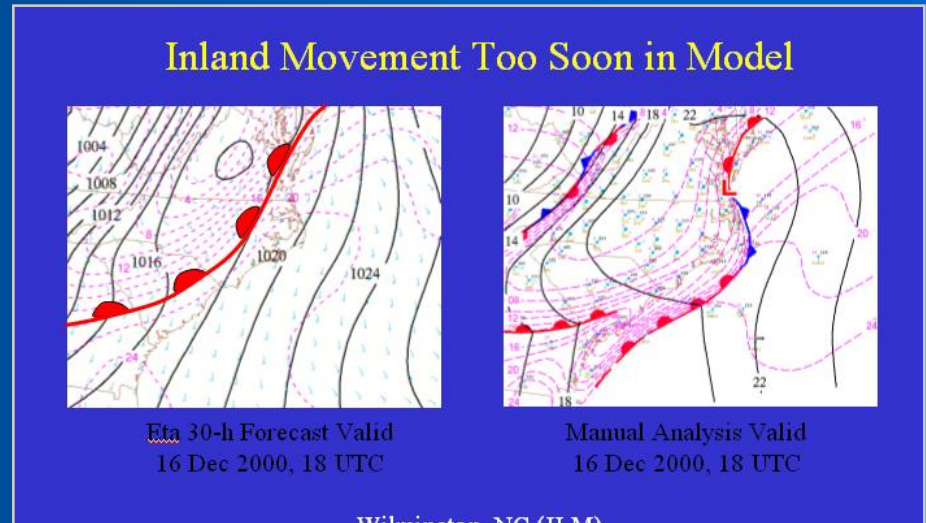
NWS-NCSU Collaborations: A long and storied road

- 1990s:
 - Joint Severe Weather Collaboration
 - 38 students participated
 - 78 events, covering 277 hours
 - Warning decision process thoroughly analyzed
 - Benefited both students and NWS
 - Coastal flood model
 - Algorithm for determining winter precipitation type
 - Assessment of coastal cyclone intensification rates & development of forecast index

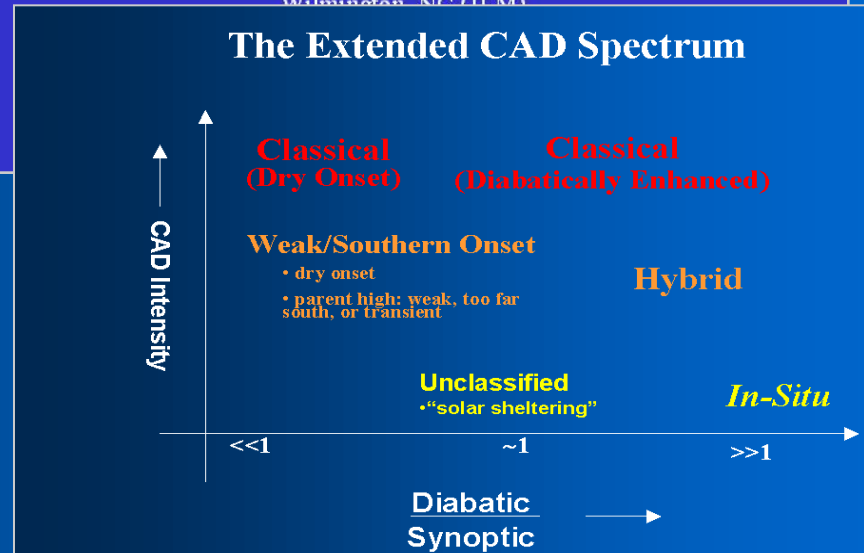


NWS-NCSU Collaborations: A long and storied road

- 2000s:
 - 3 major NOAA-funded projects and other NSF and COMET projects; numerous papers & case studies published
 - Several VISITview seminars for NWS offices
 - Cold air damming climatology & development of classification system
 - Coastal front climatology & forecast aids



Wilmington, NC (ILM)

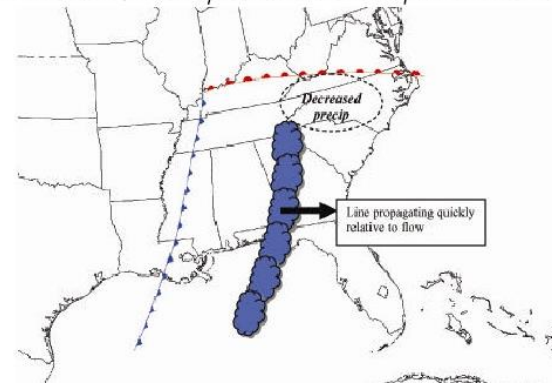


NWS-NCSU Collaborations: A long and storied road

- 2000s (continued):
 - Assessing the effects of Gulf Coast storms on precipitation amounts in the Carolinas/mid-Atlantic region
 - Case studies led to conceptual models
 - Concepts have been applied operationally with success
 - Potential vorticity: “PV thinking” in operational forecasting

Case A (Scenario 1): December 31, 2002

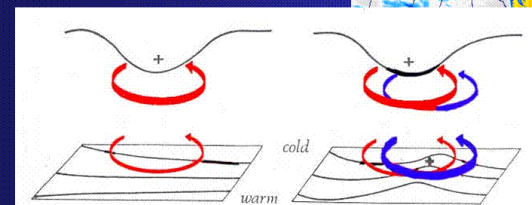
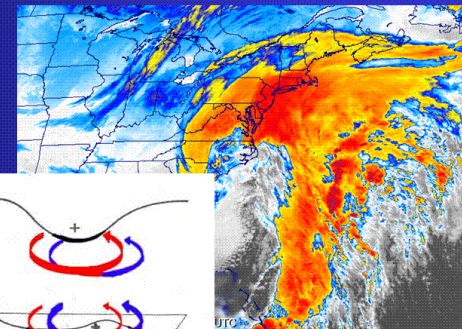
Scenario 1: Upstream convection oriented parallel to flow. System propagating quickly, perpendicular to flow. (These cases would be expected to show decreased downstream precipitation as a result of interrupted moisture transport or other mechanisms.)



The Impact of Latent Heating on Extratropical Cyclones: Using the PV Framework in Operations

Michael Brennan

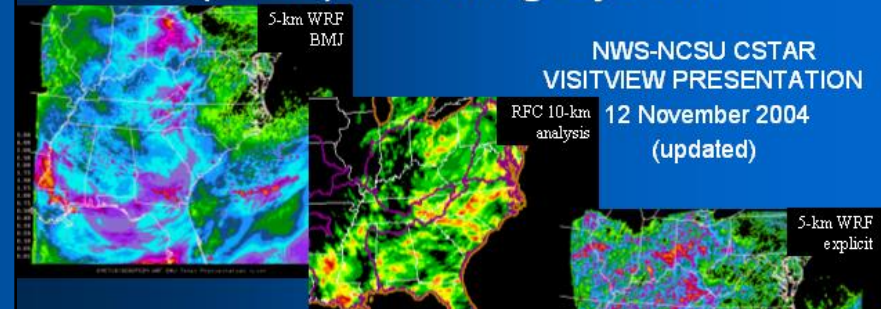
NC STATE UNIVERSITY



NWS-NCSU Collaborations: A long and storied road

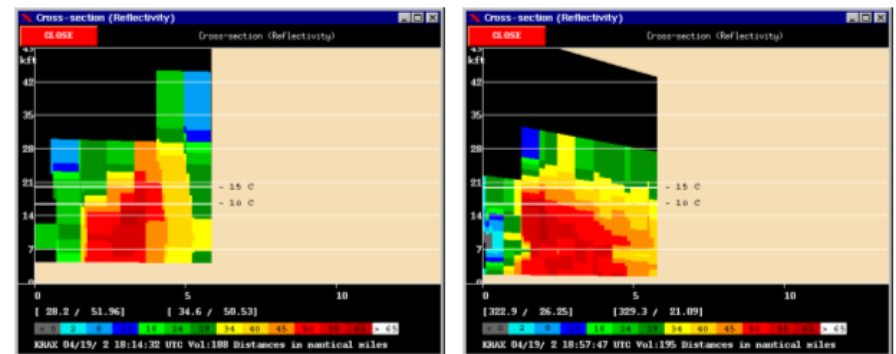
- 2000s (continued):
 - Introduction to the Weather Research & Forecast (WRF) modeling system
 - Radar technique for forecasting the first lightning strikes was developed **and implemented operationally**

An Operational Introduction to the Weather Research & Forecasting (WRF) Modeling System



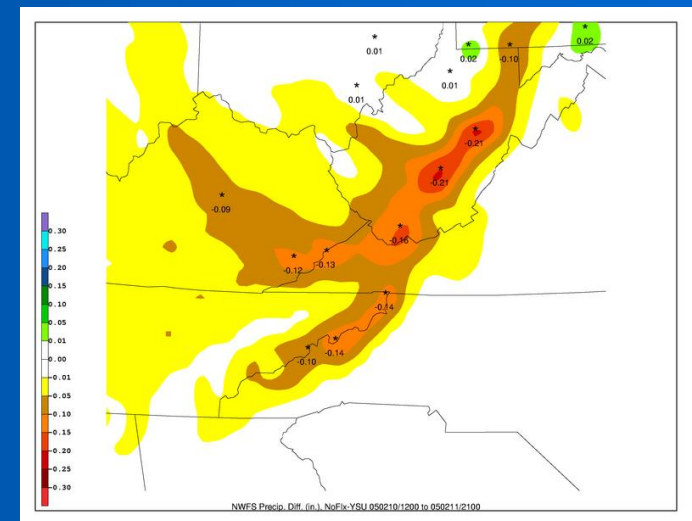
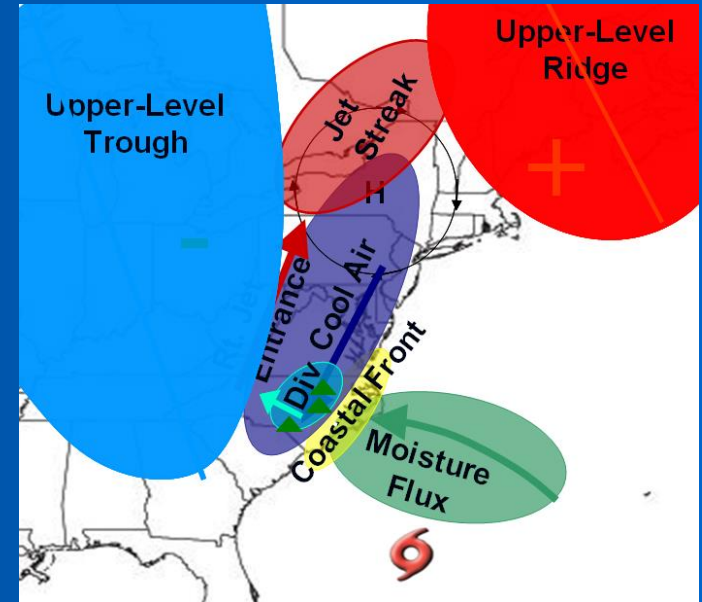
Detection Examples

Reflectivity of 40 dBZ and greater easily exceeded the -10°C and -15°C heights



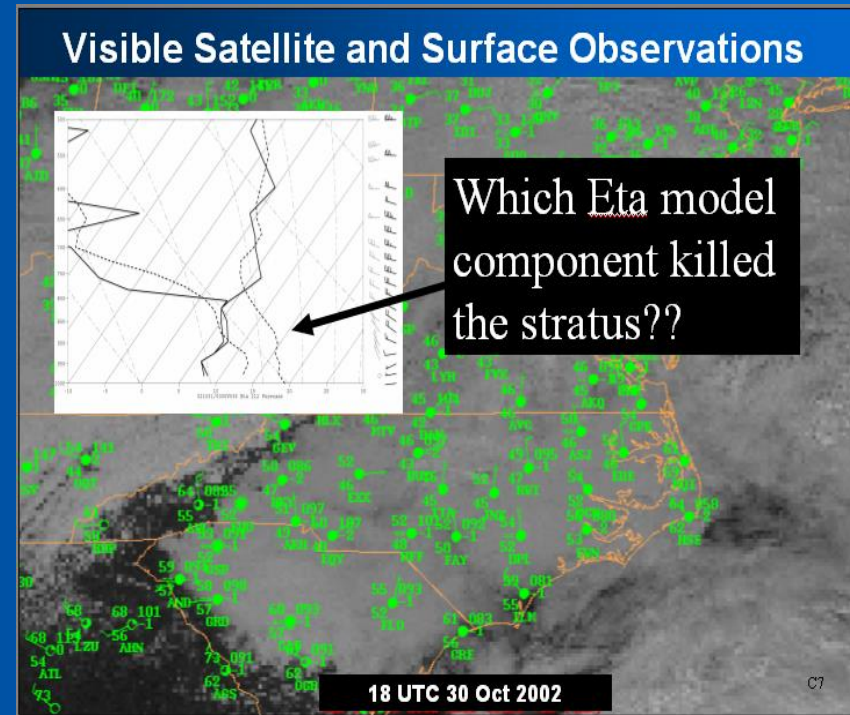
NWS-NCSU Collaborations: A long and storied road

- 2000s (continued):
 - Examining Multi-Scale Features that Enhance Precipitation Associated with Landfalling Tropical Cyclones in North Carolina
 - The Role of the Great Lakes in Northwest Flow Snowfall in the Southern Appalachian Mountains

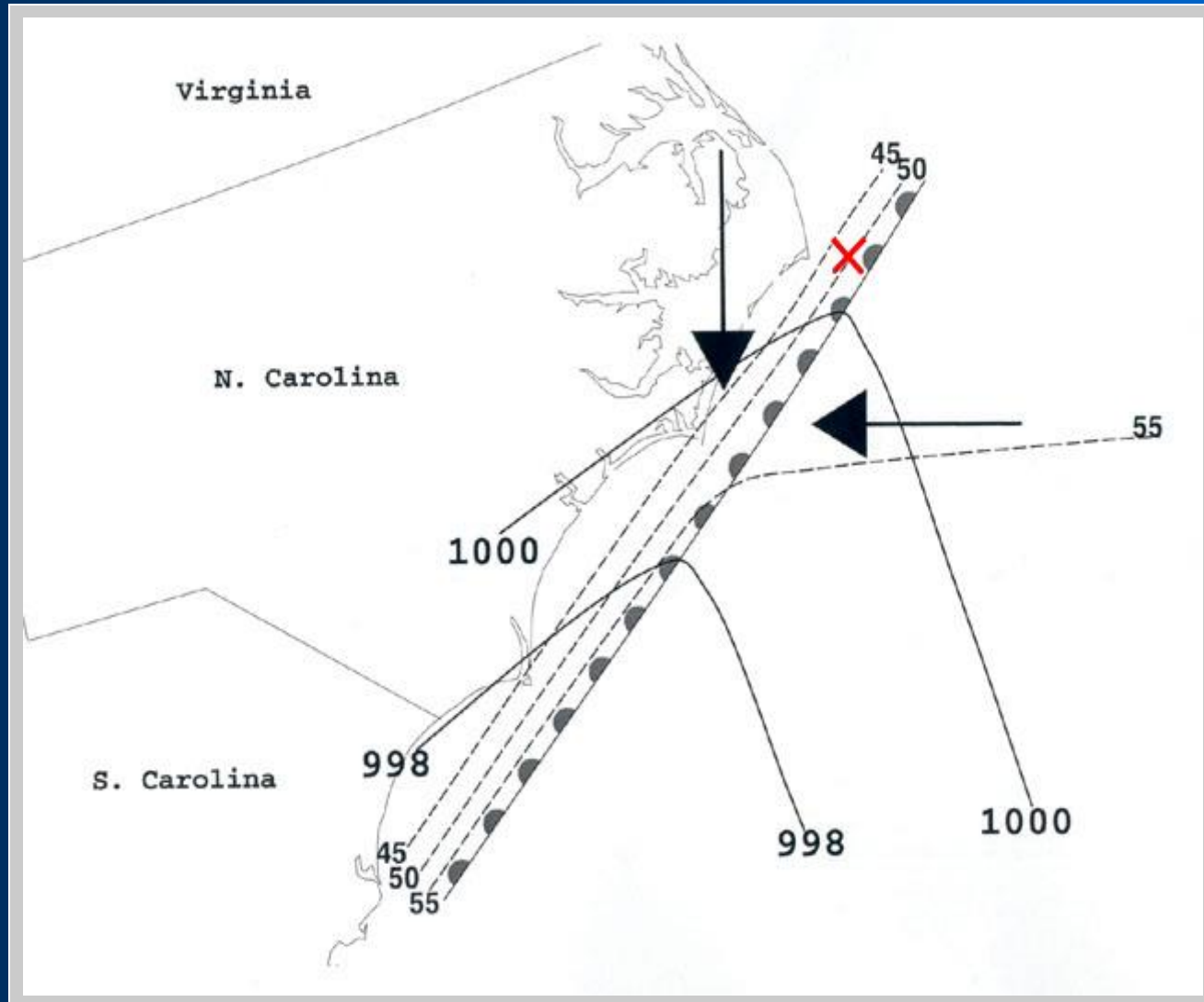


NWS/NCSU Research Focus

- Forecast Problems...for example:
 - Poor representation of coastal fronts and cold air damming by models
 - Coastal front forecast problems: inland movement, timing, sensible weather
 - Cold air damming forecast problems: development and erosion, precipitation amounts & type
 - Precipitation amounts: addressing deficiencies in the computer models in the mid-Atlantic/Carolinas
- Research Strategy:
 - Climatologies
 - Case study analysis, modeling



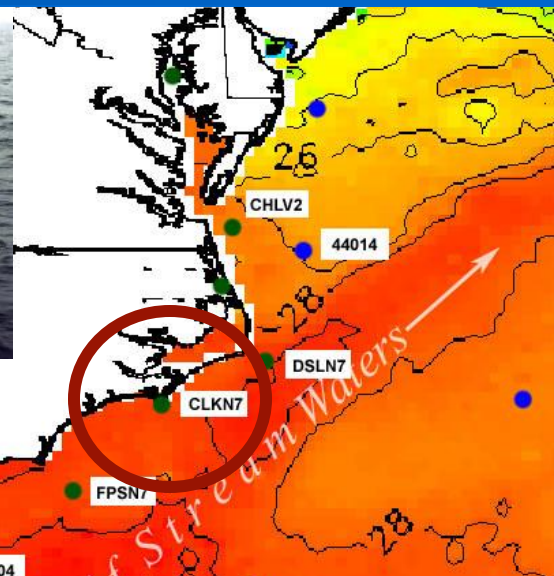
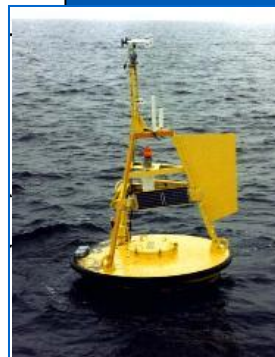
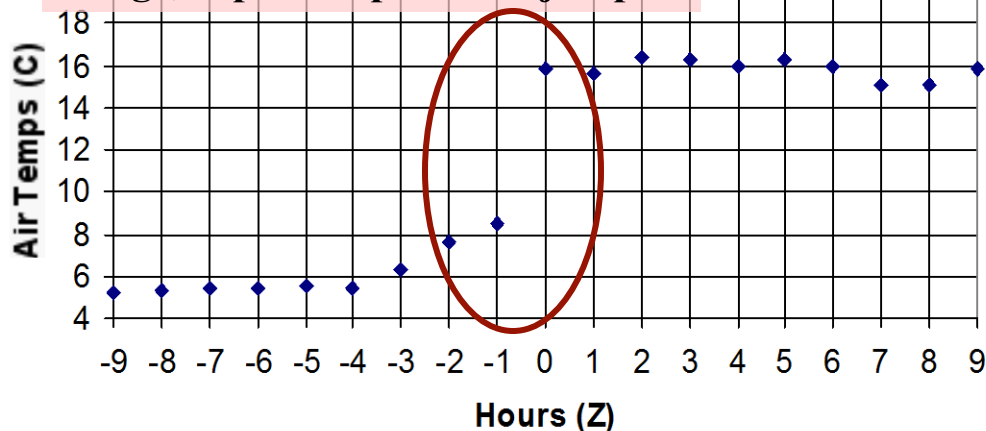
An example: How does the weather evolve as coastal front passes?



Accurate forecasts for coastal FP are critical!

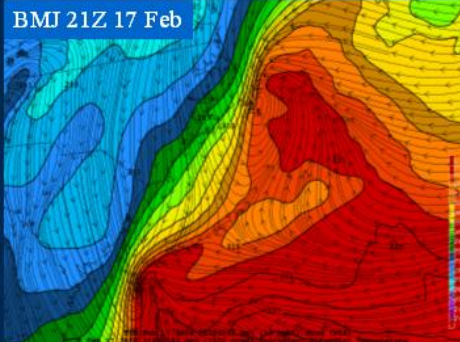
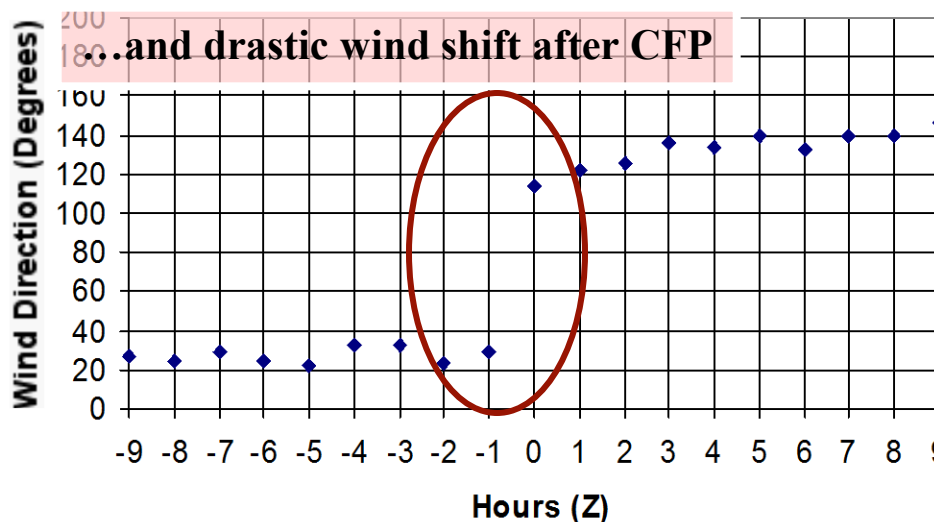
CLKN7: 12/10/92 9Z

Large, rapid temperature jump...



CLKN7: 12/10/92 9Z

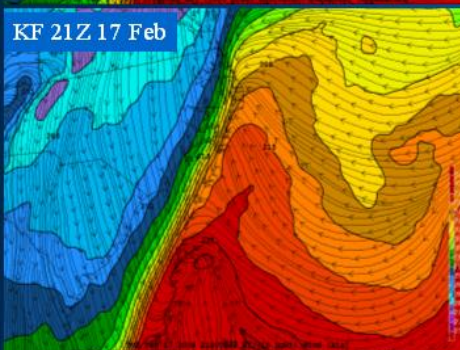
...and drastic wind shift after CFP



Coastal Front Representation

BMJ

- less-defined coastal front
- farther offshore
- distinct surface cyclone centers



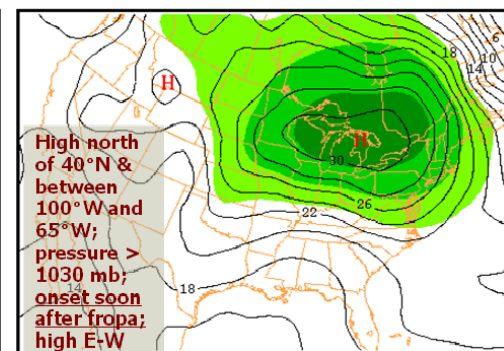
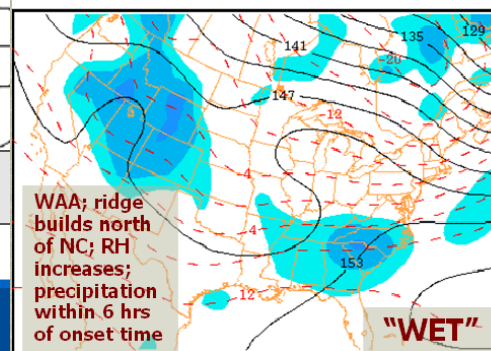
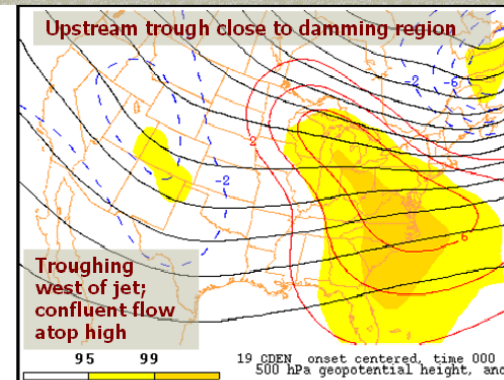
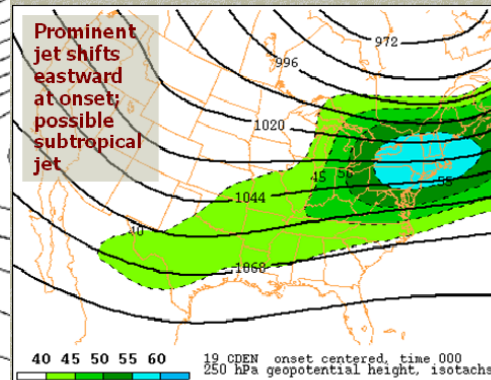
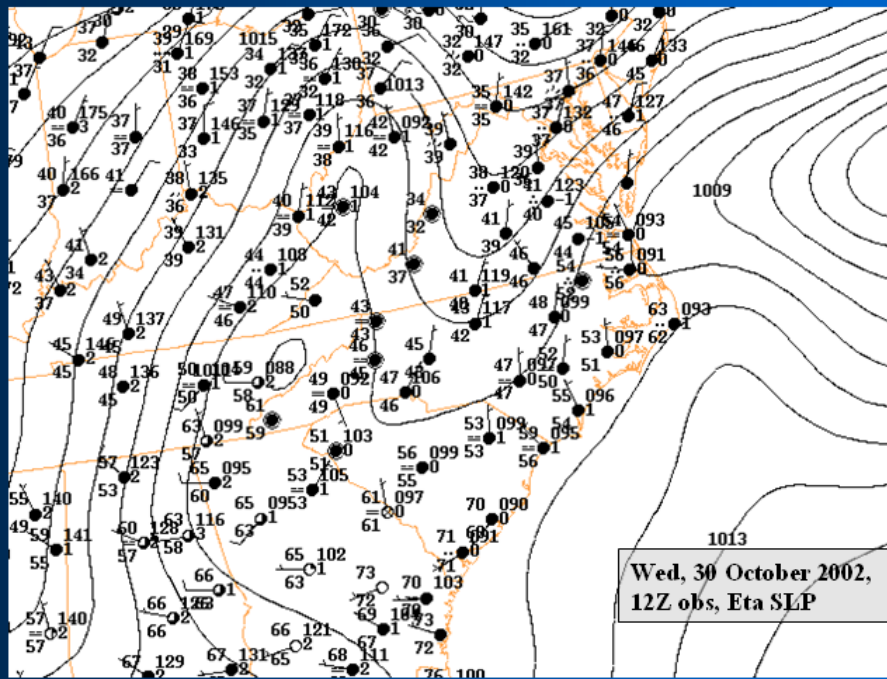
KF

- better-defined
 - stronger temperature gradient
 - more convergence
- closer to coast
- less distinct cyclone centers

What have we learned about cold air damming ?

- There are many different varieties
- It is not limited to the cool season
- Weather impact (clouds, temps, weather) correlates to specific patterns, surface and aloft
- Erosion: 4 distinct synoptic scenarios & 5 erosion processes were identified

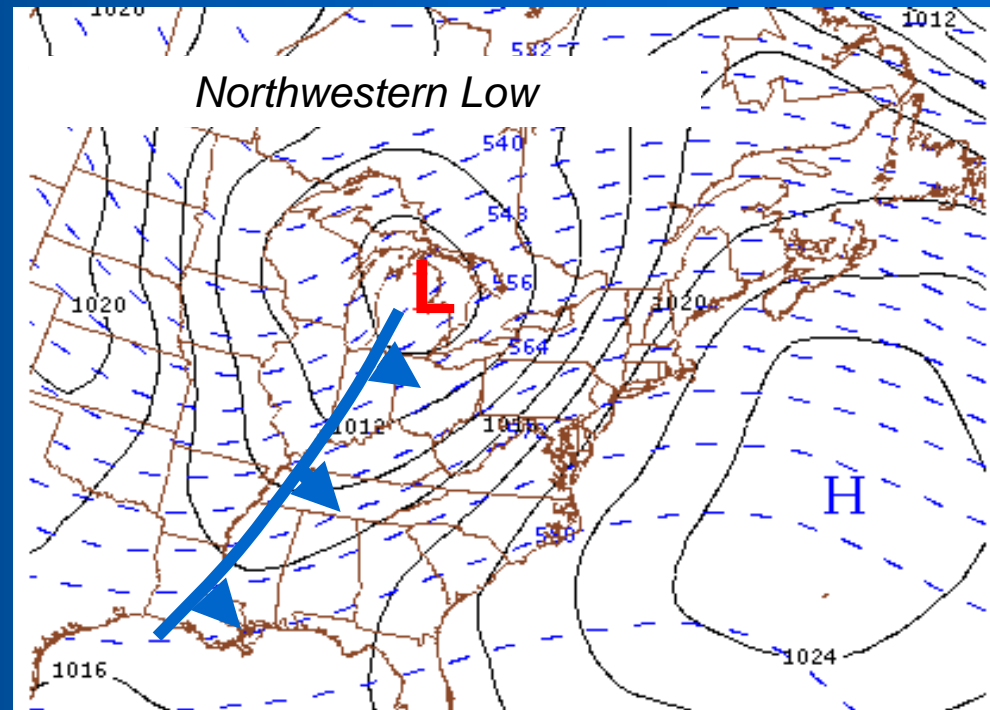
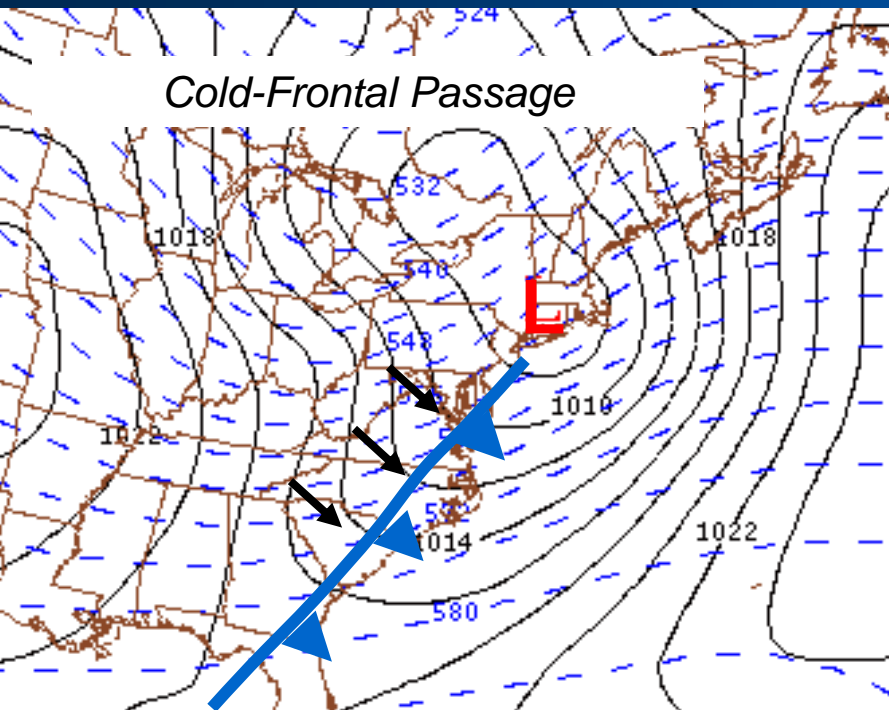
1) Classical, Diabatically Enhanced (CDEN)



Research findings: cold air damming erosion scenarios

**Cold-Frontal Passage:
Relatively small model error**

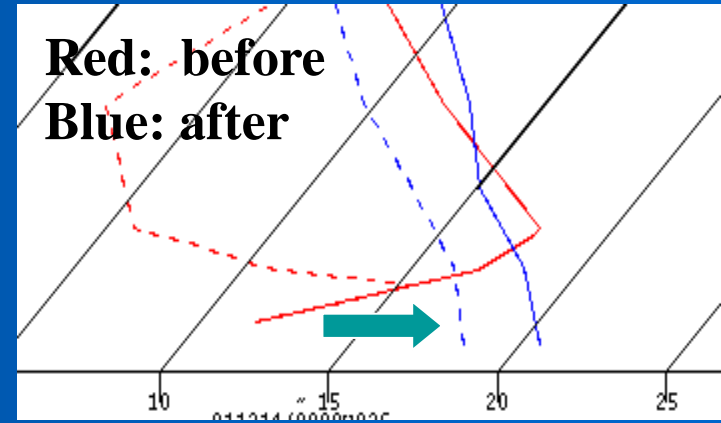
**Northwestern Low (no CFP):
Large model error**



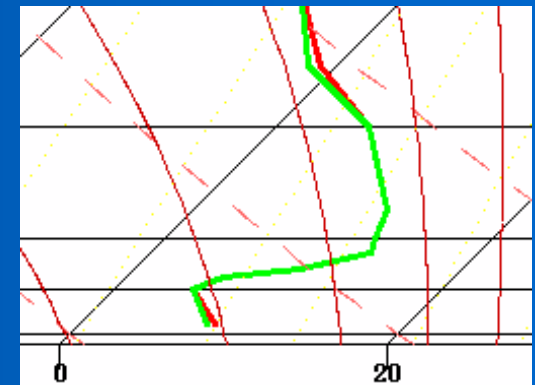
...These findings were brought directly into operations,
and immediately resulted in improved forecasts

Research finding: cold air damming erosion processes

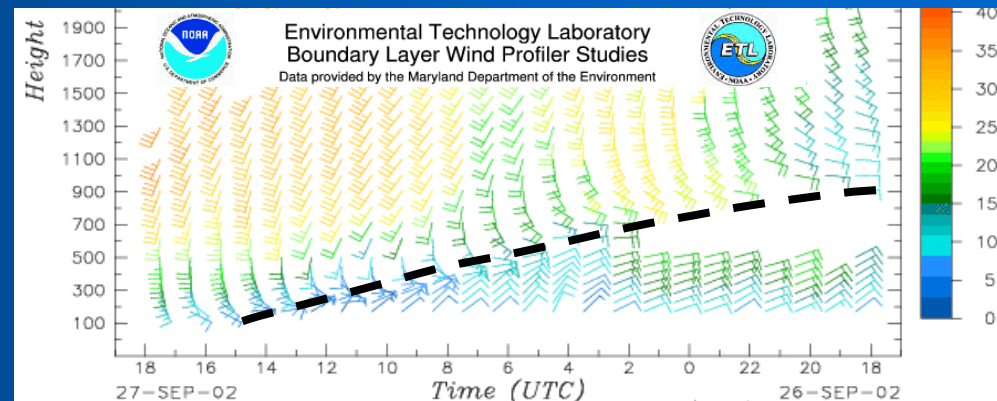
- Surface heating (bottom-up erosion) →
 - Eta allows excessive surface heating; premature erosion results



- Cold advection aloft (promotes mixing) →
 - Can be problematic for models



- Shear-induced mixing at inversion (“top-down” erosion) →



Fort Meade, MD ←

Winter weather computer model discoveries

- Precipitation type forecasting:
 - Comparison of techniques via case studies
 - Model discoveries: warm bias with cold air damming; cold bias with freezing rain
 - Biases depend on precipitation amounts
- Model biases:
 - Freezing rain was “misinterpreted” by one model’s physics
 - Collaboration with the National Centers for Environmental Prediction (NOAA/NWS)
 - The model’s bias was corrected

Freezing and Melting, Precipitation Type, and Numerical Weather Prediction

A Webcast by Dr. Gary M. Lackmann
Department of Marine, Earth, and Atmospheric Sciences
North Carolina State University

Produced by the COMET® Program



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...These findings were brought directly into operations via web pages and training sessions, and immediately resulted in improved forecasts for cold air damming and ice (glaze) accrual



More research results

- Transfer of research findings via:
 - Online case studies, hard copy materials (posters)
 - Site visits, co-labs, online training sessions, webcasts

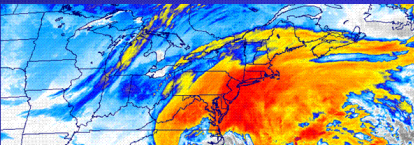
http://www42.ncsu.edu/eos/service/pam/meas/scp/research/rtwd/rtwd_20041216.ppt

NC STATE UNIVERSITY

The Impact of Latent Heating on Extratropical Cyclones: Using the PV Framework in Operations

Michael Brennan


NC STATE UNIVERSITY



An Objective Climatology and Classification Scheme for Appalachian Cold Air Damming


A WFO Staff Training Presentation

Created by Gail Hartfield
WFO Raleigh, NC



Freezing and Melting, Precipitation Type, and Numerical Weather Prediction

A Webcast by Dr. Gary M. Lackmann
Department of Marine, Earth, and Atmospheric Sciences
North Carolina State University
Produced by the COMET® Program



NCAR Photo Library

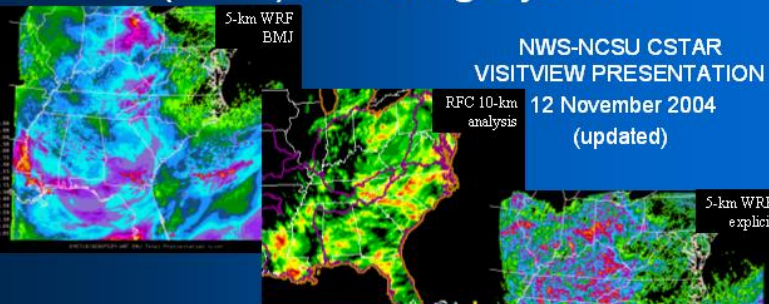
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Contributors | Tech Notes | User Survey | Bibliography

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An Operational Introduction to the Weather Research & Forecasting (WRF) Modeling System

NWS-NCSU CSTAR VISITVIEW PRESENTATION
12 November 2004 (updated)



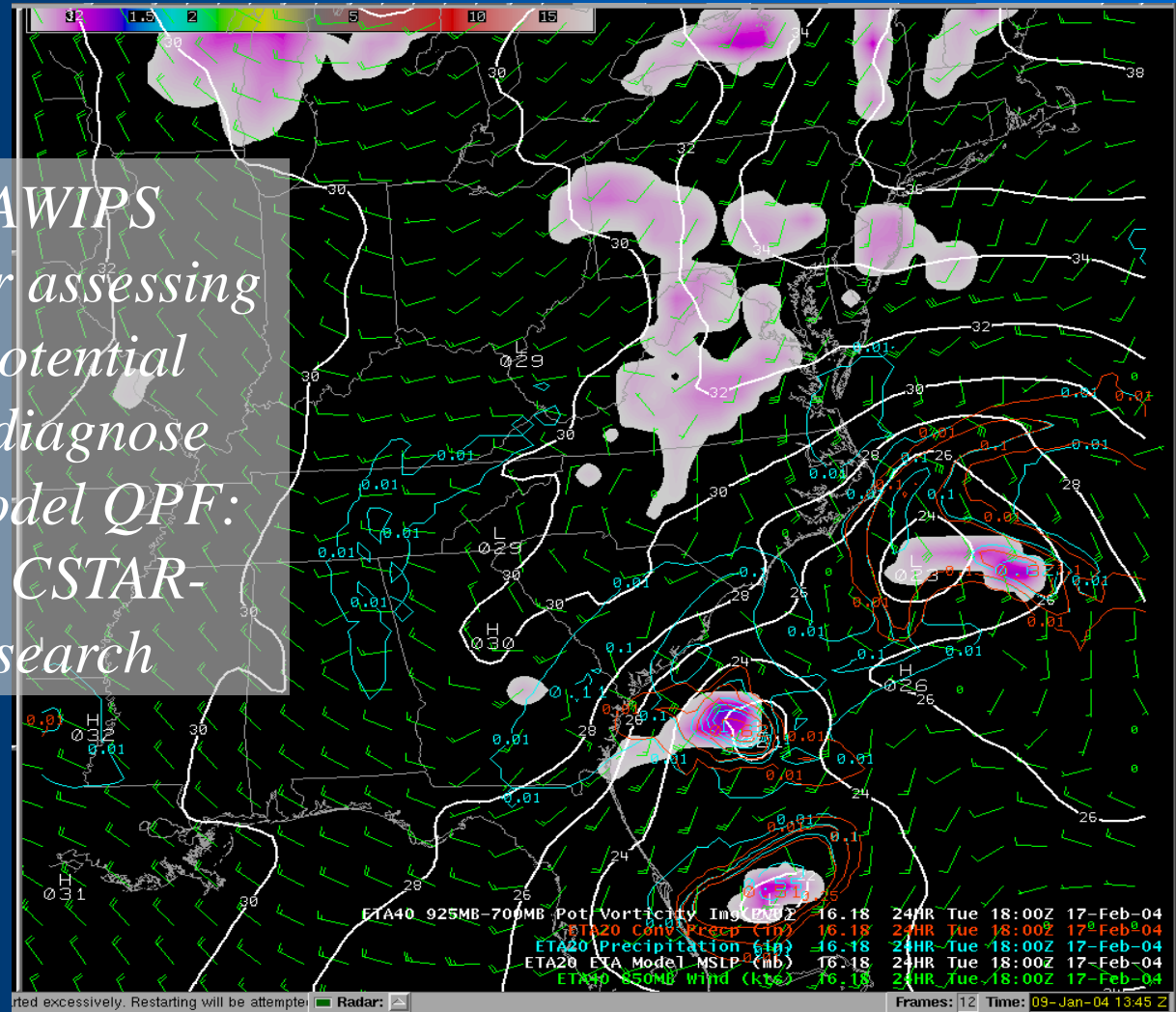
Gary Lackmann, NCSU
With contributions from
Michael Brennan, Stephen Jascourt, Jeff Waldstreicher, Kelly Mahoney, David Novak, Steven Koch, Wei Wang, WRF Tutorial Class & others



More research results

- Development of computer-based procedures to facilitate real-time application of research results

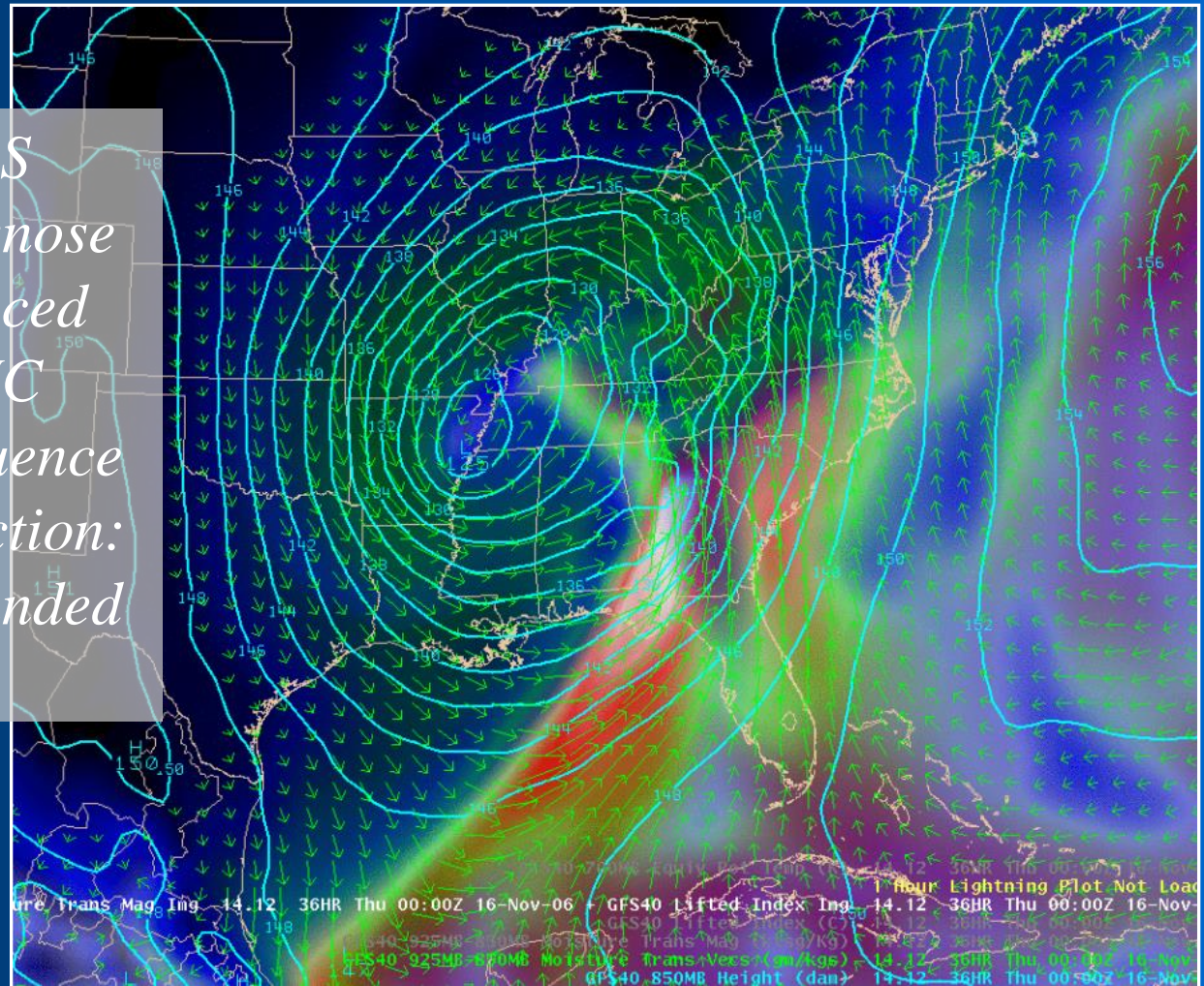
Targeted AWIPS procedures for assessing low-level potential vorticity to diagnose erroneous model QPF: COMET- & CSTAR-funded research



More research results

- Development of computer-based procedures to facilitate real-time application of research results

Targeted AWIPS procedures to diagnose potential for reduced convection in NC resulting from influence of upstream convection: current COMET-funded project



Research results

- Operational enhancements:
 - Improved pattern recognition
 - Objective detection and classification algorithms
 - Area Forecast Discussions reflect the science behind the predictions
 - Our single most popular web page product* →
 - Forecasters can now better recognize physical processes, and biases & weaknesses of models
 - Has resulted in improved weather forecasts

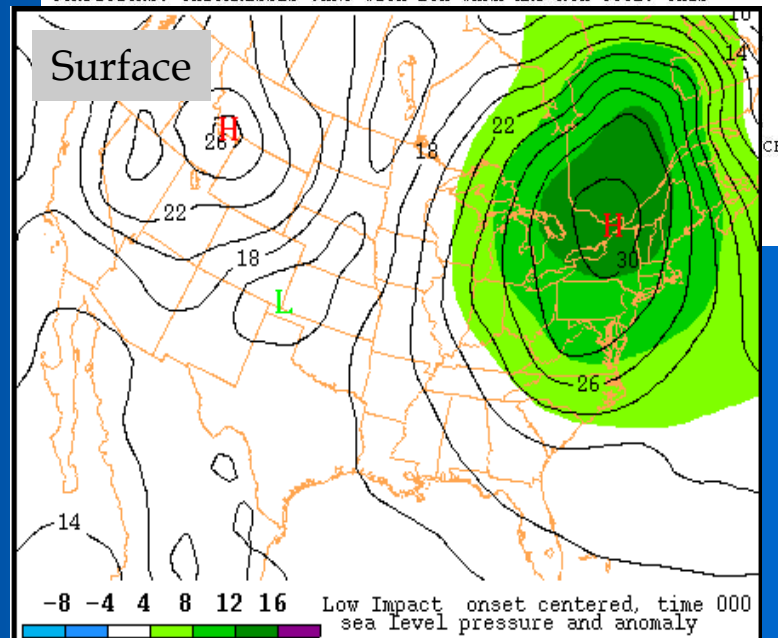
FXUS62 KRAH 071938
AFDRAH

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE RALEIGH NC
235 PM EST FRI JAN 7 2005

.SHORT TERM (TONIGHT THROUGH MONDAY)...
TONIGHT...WEAK HIGH PRESSURE SLIDING OFFSHORE TONIGHT WITH LIGHT SOUTHEAST FLOW DEVELOPING IN THE LOW LEVELS. THEN MODELS INDICATING WARM FRONTAL (DEWPOINT BOUNDARY) LIFTING NORTH ACROSS THE AREA LATE TONIGHT (06Z-12Z) AS LOW PRESSURE LIFTS NORTHEAST ACROSS THE TENNESSEE VALLEY. CHANCE FOR RAIN OVERNIGHT LOOKS SLIM WITH THE BEST CHANCE OVER NORTHWEST WHERE AREA OF LIFT/MOISTURE CONVERGENCE CROSS TOWARD DAYBREAK. TIME/HEIGHT CROSS SECTIONS AND FORECAST SOUNDINGS INDICATE PLENTY OF MOISTURE INTO CWA OVERNIGHT. SO WILL INDICATE SMALL CHANCE OF SHOWERS NORTHWEST AND FAR NORTH WITH MAINLY SPRINKLES FOR THE REST OF THE CWA. MILD TEMPERATURES WILL CONTINUE WITH READINGS IN THE UPPER 40S TO LOWER 50S.

A FEW STRAY SHOWERS/SPRINKLES POSSIBLE FAR N EARLY SATURDAY THEN PASSAGE OF MID LEVEL TROUGH VEERS FLOW TO WESTERLY AND DRIES COLUMN OUT BY MID DAY. SURFACE FRONT CROSSES AREA LATE SATURDAY AFTERNOON/EARLY EVENING.

SURFACE RIDGE OVER CENTRAL NC SUN SHOULD PROVIDE REGION WITH DRY CONDITIONS. THICKNESSES VARY WITH ETA WARM AND NGM COOL. THIS



More results: Operational web pages, references, & forecast tools

Vast archive of winter, severe, & tropical case studies (contributions by NWS forecasters & NCSU students/faculty)
www.erh.noaa.gov/rah/events/

Past Events
 Information on Winter Storms, Severe Weather Outbreaks, and Other Events of Interest:

- Case Study and Event Summary of the December 26, 2004 Winter Storm
- Precipitation and Accumulation Map of the December 19-20, 2004 Winter Storm
- Event Summary of Hurricane Jeanne and the Tornadoes in Moore and Wake Counties **NEW!**
- Event Summary of Hurricane Ivan and the Stokesdale Tornado **NEW!**
- Event Summary of Hurricane Frances
- Event Summary of Tropical Storm Gaston
- Event Summary of Hurricane Charley
- Event Summary of the August 12, 2004 Severe Thunderstorm and Tornado Event
- Event Summary of Hurricane Alex
- Event Summary of the July 14, 2004 Severe Thunderstorm Event

The Impact of Latent Heating on Extratropical Cyclones: Using the PV Framework in Operations

Michael Brennan
 NC STATE UNIVERSITY

Archived presentations from training sessions

NC STATE UNIVERSITY
 Winter Precipitation Type Forecasting Tools

Note: These products should update automatically, but this website is not considered operational and thus no guarantees are made about the availability of the data.

Partial Thickness Charts

Note: The partial thickness technique is best suited for sites located inland from the immediate coast where the elevation is less than 1,500 ft.

RUC hourly analyses

The above plots show the RUC analysis of 1000-850 mb thickness (blue) and 850-700 mb thickness (red) with observed present weather and wet-bulb temperature in Fahrenheit (green) updated minutes past the hour. Images are archived for a 24-hour period and then overwritten.

Real-time partial thicknesses and short-range forecasts for precipitation type diagnostics & forecasting
 (tempest.meas.ncsu.edu/pthick/)

Model Forecasts

ETA 211	F00	F06	F12	F18	F24	F30	F36	F42	F48	F54	F60	Loop
ETA 212	F00	F06	F12	F18	F24	F30	F36	F42	F48	F54	F60	Loop
ETA 213	F00	F06	F12	F18	F24	F30	F36	F42	F48	F54	F60	Loop

The above plots show 1000-850 mb thickness (blue) and 850-700 mb thickness (red) with the precipitation forecast for the previous 6-hour period from the model (color shading) ending at the time of the analysis. Solid shading indicates precipitation entirely below freezing (partially above freezing) dashed (solid).

Messages - Microsoft Internet Explorer

Address: <http://list.nws.noaa.gov/read/?forum=cstar>

LYRIS ListManager

Current forum: cstar
 You are: gail.hartfield@noaa.gov

Messages Search Conference My Account My Forums All Forums About

Messages

Date	Subject	Replies	Author
2005-01-06 08:20:00	[Fwd: Re: Dec 26th Hampton Roads Snow]	1	John Billet
2005-01-05 14:30:00	Dec 26th Hampton Roads Snow	2	John Billet
2004-12-25 14:45:00	convective scheme feedback and coastal cyclone evolution	1	Michael Brennan
2004-12-16 16:47:00	AWIPS PV Procedure - from the Use of PV thinking in Operational Forecasting Visit Session	0	Jonathan Blaes
2004-12-15 09:13:00	PV Visit View Materials for Thursday, December 16 at 3:00 PM - UPDATE	0	Jonathan Blaes
2004-12-07 10:44:00	Second offering of PV VISIT session	11	Michael Brennan
2004-12-06 12:30:00	Reminder - Materials for the "Use of PV thinking in Operational Forecasting" ARE AVAILABLE	0	Jonathan Blaes
2004-12-03 12:59:00	PV Visit View Materials for Tue., Dec. 7, at 800 AM ARE NOW AVAILABLE	0	Jonathan Blaes

Group listserver for collaboration, information sharing, research updates, discussions of operational successes/failures

NCSU student internship course at NOAA-NWS Raleigh

- Credit course; began in 2004 and continues today
- Students gain real-world experience, learn typical NWS tasks
 - Collecting hydrometeorological data, data analyses, introduction to forecast/warning processes and forecast preparation methodologies
 - Students keep journal of experiences & attend various training courses



The NWS/NCSU Collaboration Process:

Transferring and implementing research results to achieve long-lasting benefits (“connecting the dots”)

<http://www.meas.ncsu.edu/nws/>

Level 1 - Discover & Share (Only the beginning)

Level 2 - Demonstrate added value (So what? Show me!)

Level 3 - Operational Implementation (Practical?)

Level 4 - Mastery (By all, not a few)

Level 5 - Periodic review (A necessity)



**NOAA/National Weather Service and
North Carolina State University
thank you for your interest in our collaborations!**

Visit us at

<http://www.meas.ncsu.edu/nws/>

Some images courtesy of Michael Brennan, Dr. Gary Lackmann,
Dr. Al Riordan, Kelly Mahoney, Keith Contre, and Wendy Sellers
(NCSU); and Gail Hartfield, Rod Gonski, Jonathan Blaes, and
Kermit Keeter (NWS RAH)

