NWS ALY Perspective on CSTAR (2001-2024)

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NOAA/NWS Albany, NY

25th Northeast Regional Operational Workshop
November 13-15, 2024

Collaborative Science, Technology, and Applied Research Program

- FY00 – NOAA initiated a grant program to fund collaborative research activities between the academic institutions and operational offices in the National Weather Service
- The goal of CSTAR was to create a cost-effective framework to conduct basic and applied research and transfer results into operations (Research to Operations (R2O))
- Grants were awarded up to 3 years (CSTAR I with UAlbany was 2001-2004; CSTAR II (2004-2007)), etc. for awarded projects that address NOAA and NWS priorities
- 10 Academic institutions were awarded grants in the first 5 years (2000-2005): NCSU, UAlbany, FSU, OU, Utah, UWashington, Texas A&M, SLU, URI and DRI (NV)
- Collaborative research allowed NOAA priorities to be achieved over the past 2 decades (7 CSTAR grants with UAlbany (2001-2024))

A Few Former Students

(Tom, Neil or Ken LaPenta worked with)

- Brandon Smith (NCEP/AWC/FAA Command Center)
- Jessica Najuch (Educator – western NY)
- Patrick Wilson (Meteorologist – NWS Blacksburg)
- Matthew Scalora (Lead Meteorologist – NWS Wilmington, NC)
- Jonas Asuma (Lead Meteorologist – National Grid Renewables)
- Melissa Payer Sulprizio (Senior Scientific Software Engineer – Harvard U.)
- Dan Thompson (SOO – NWS Marquette)
- Rebecca Steeves (Research Associate at OAR)
- Pamela Eck (Senior Cyber Risk Consultant – Verisk Analytics)
- Tomer Berg (WPC Testbed Meteorologist)
- Brennan Stutsrim (E Source Data Scientist/Applied Meteorologist)
- Brian Filipiak (UConn working on doctorate)
- Rachel Eldridge (Data Scientist – Ground Work Renewables)

Snow Banding (Novak 2004)

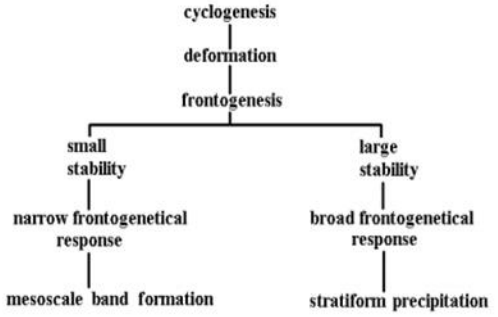


Fig. 4.7. Flow chart of the key components and interactions involved in band formation.

Novak D.R., L.F. Bosart, D. Keyser, and J.S. Waldstreicher, 2004: An observational study of cold season-banded precipitation in northeast U.S. cyclones. *Wea. Forecasting*, **19**, 993-1010.

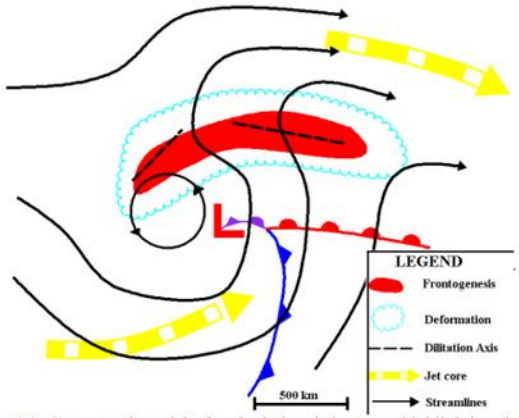


Fig. 4.1. Conceptual model of a single-banded system highlighting the key parameters. Features drawn include 700 hPa frontogenesis (shaded), 700 hPa deformation zone (encompassed by scalloped line) and associated primary dilatation axes (dashed line), 700 hPa streamlines (black lines), and 300 hPa jet cores (wide dashed arrows).

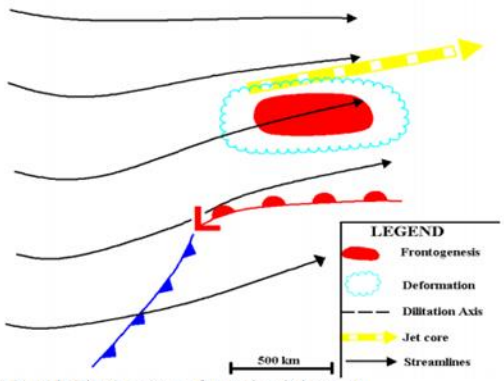
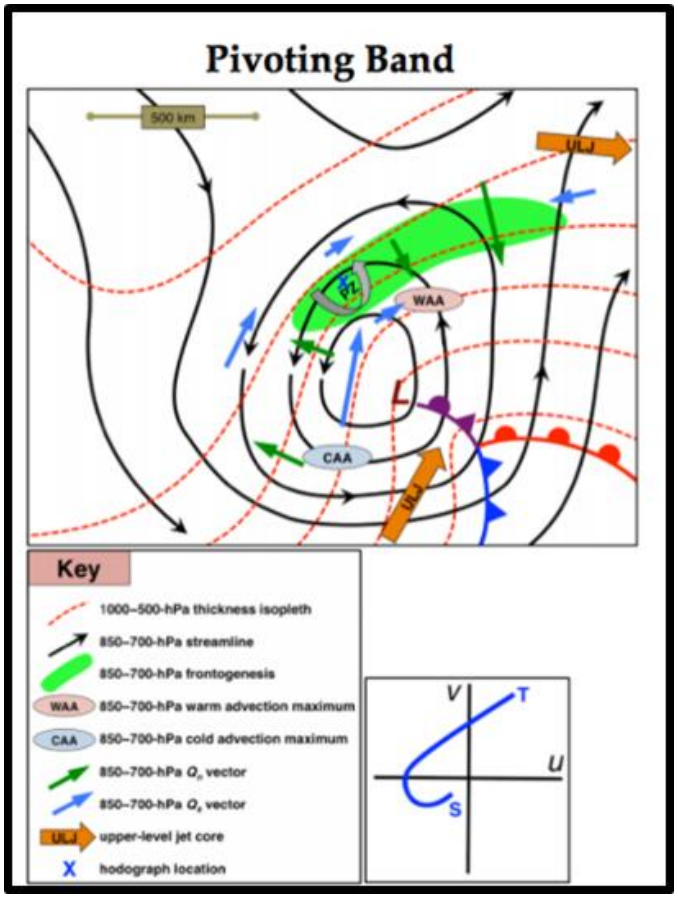
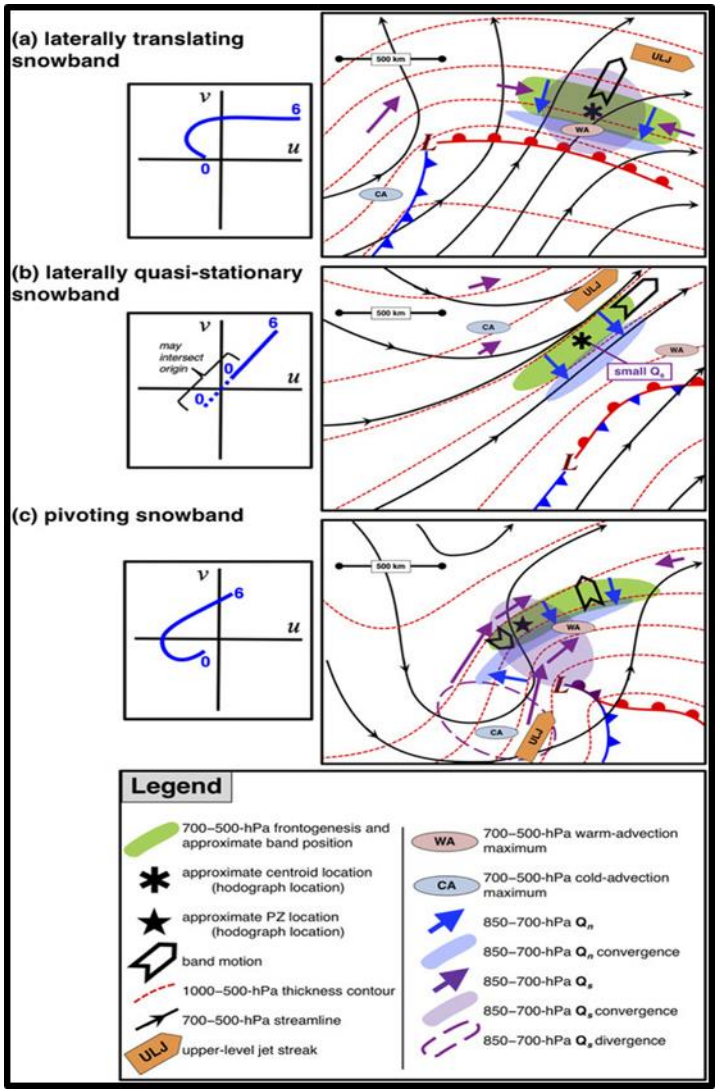


Fig. 4.2. As in Fig. 4.1, except for nonbanded system.

Banded Snowfall (Kenyon 2013)





NATIONAL WEATHER SERVICE

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

AFD Examples: Snowbanding

AREA FORECAST DISCUSSION
National Weather Service Albany NY
940 PM EST Wed Feb 22 2023

.NEAR TERM /UNTIL 6 AM THURSDAY MORNING/...
The warm nose is slowly building northward and the precipitation will become mixed in the Capital Region perhaps by midnight. Very spotty precipitation in southern areas will continue until after midnight when precipitation should fill in again to some degree, but again as a mix. **The lengthy laterally translating band of snow (based on CSTAR research) becoming nearly stationary along and north of the Mohawk Valley, is showing some considerable reflectivity on radar and the NY Mesonet is showing snowfall rates of a half inch to inch per hour and that should add up to warning level snows in the southern Adirondacks and Lake George Saratoga Region by mid-morning Thursday.** A little less snow from the Mohawk Valley and southern VT and points south but still some ice and sleet through the night. So, some minor adjustments to snow and ice amounts in the southern half of the forecast area, and a few other touches to temperatures and probabilities of precipitation.

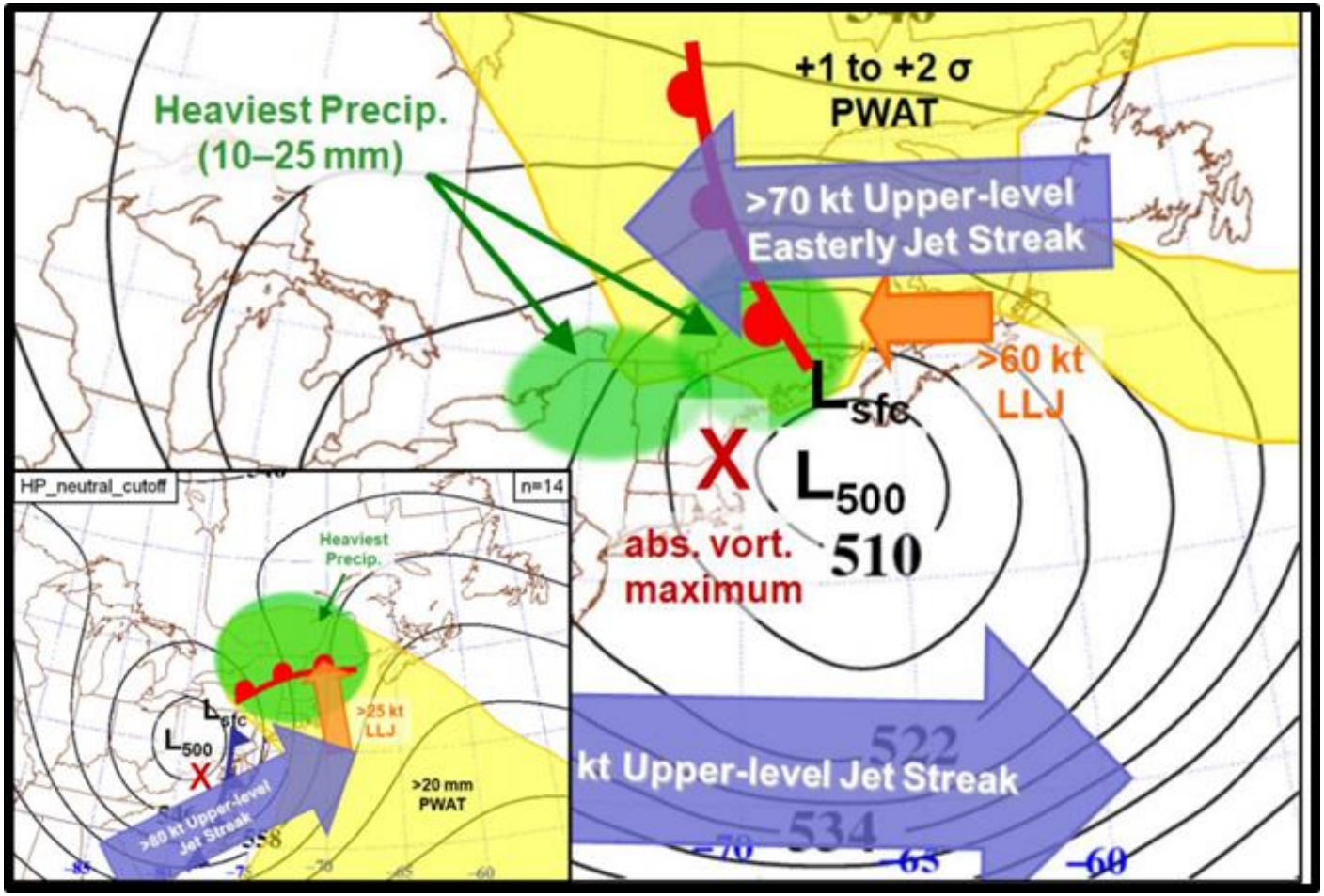
NEAR TERM...MSE/NAS

AREA FORECAST DISCUSSION
National Weather Service Albany NY
342 PM EDT Mon Mar 14 2023

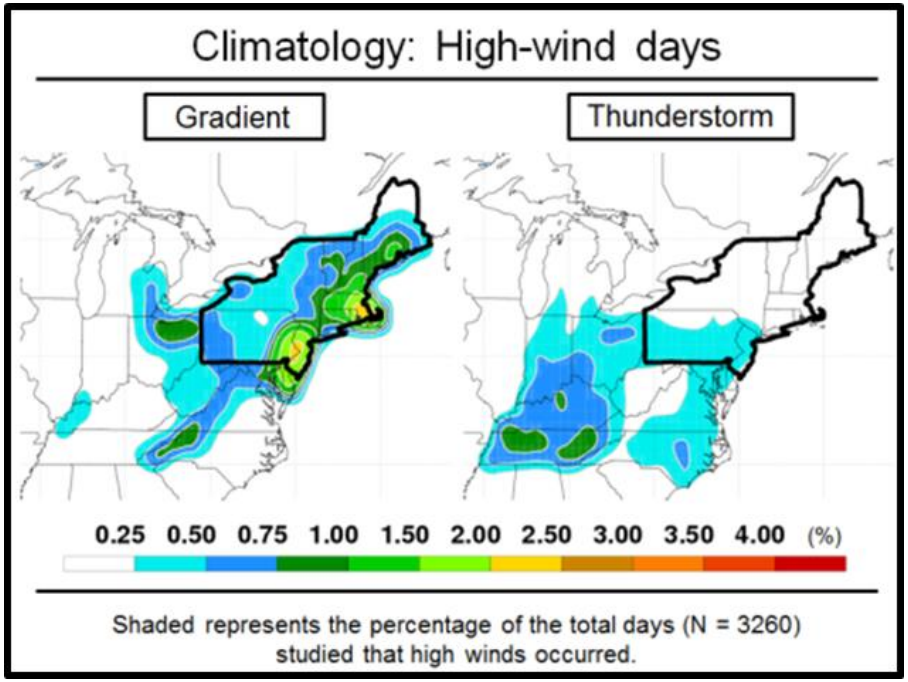
.NEAR TERM /UNTIL 6 AM TUESDAY MORNING/...
From about midnight through daybreak, bands of heavy snowfall are expected over much of the area. 12z HREF suggests a good probability of snowfall rates exceeding 1" per hour over much of the area, with even some 2" per hour rates possible for the high terrain of the Catskills. **CSTAR research suggest heavy snowbands are likely overnight across the region, with a pivoting snowband developing over the area.** The snowfall will be a very wet consistency, with ratios under 10:1 in valley areas (a little higher within the terrain). This snow load may result in some downed limbs and power lines, especially towards sunrise Tuesday. By this point, widespread 6 to 12 inches may already have fallen over a good part of the area. There could be some downsloping for a short period for areas west of the Greens (Washington County, NY especially) but it`s unclear if this will be occurring for a long enough period to cause less impacts than currently anticipated.

NEAR TERM...Frugis

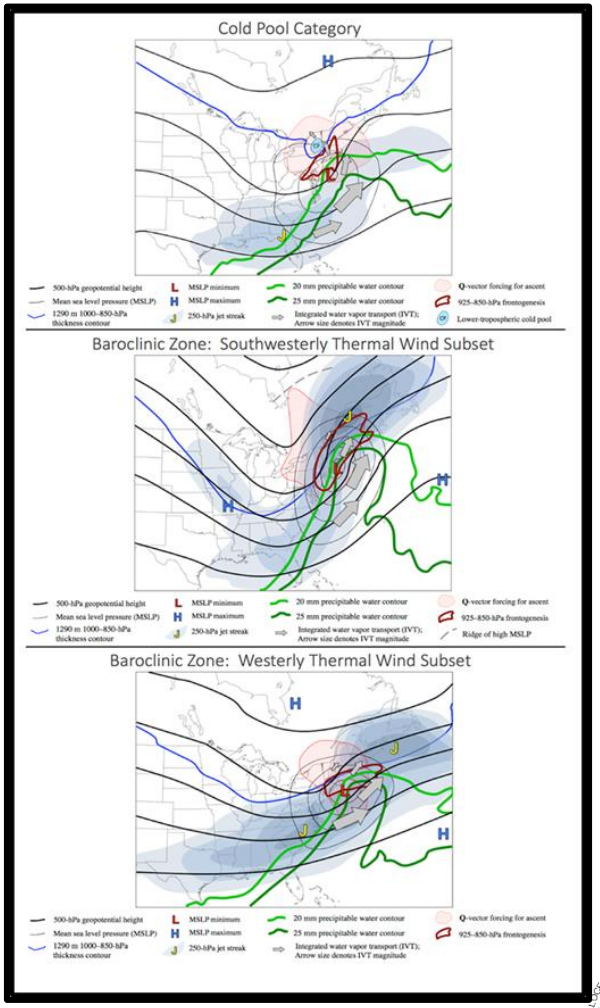
Cool Season: Upper Cut-Off Orographic Precipitation Patterns (Payer 2010)



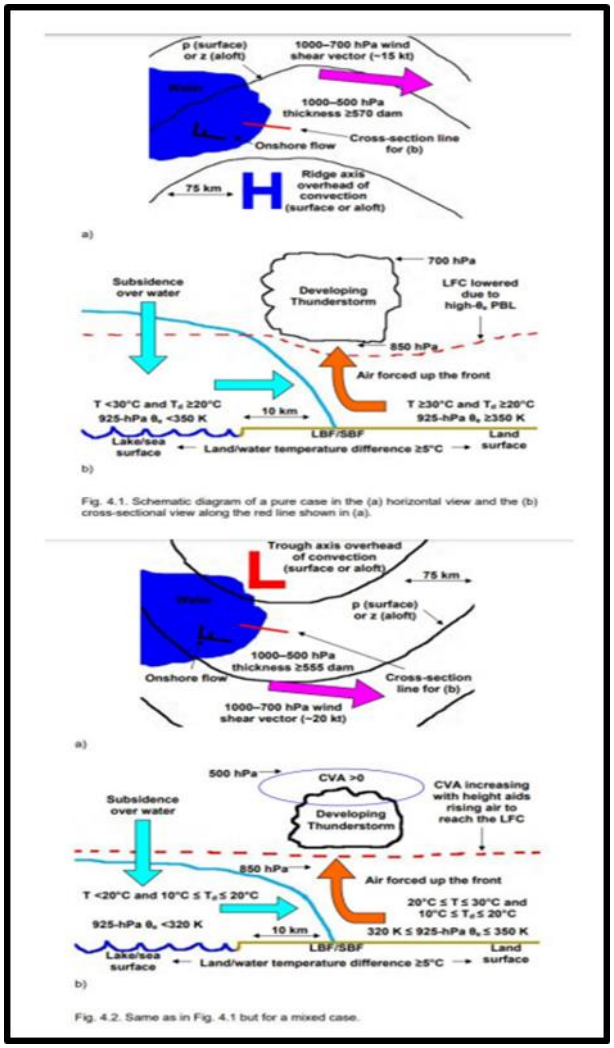
Cool-Season High Wind (Asuma 2010)



Transition Season Northeast Snowstorms (Steeves 2017)



Lake/Sea Breeze Severe Weather (Wilson 2008)



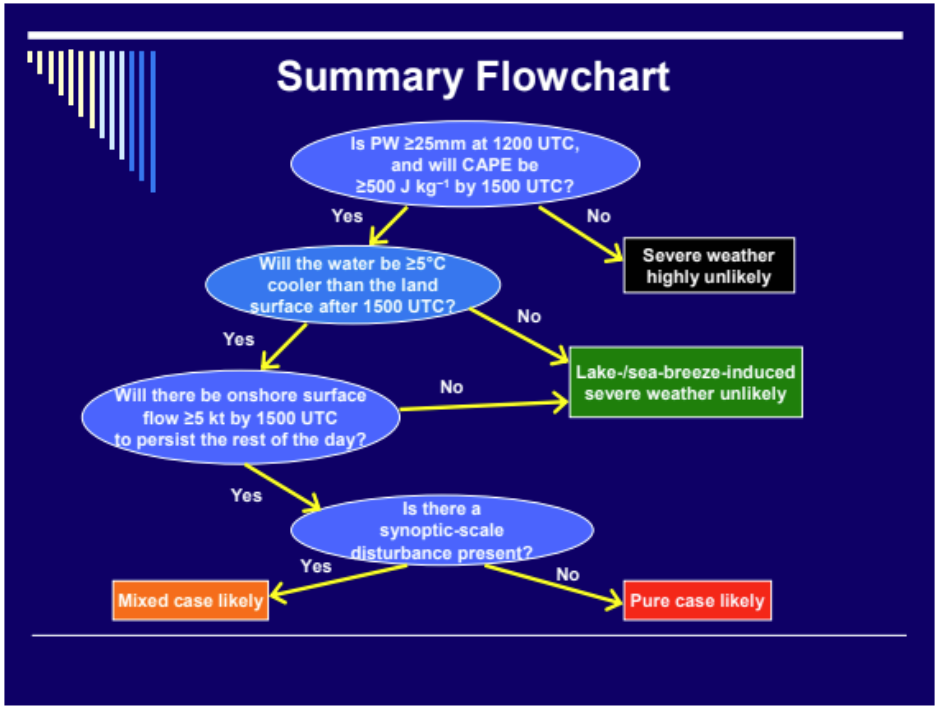


Figure 16: A summary lake/sea breeze flow chart for pure and mixed cases (Wilson, 2008).

Wasula, Wilson, Bosart, Keyser and Tracey (2008)
AMS 24th Conference on SLS Preprint
Savannah, GA 27-31 October 2008

Warm Season Closed Lows (Scalora 2009)

Patterns for heavy rainfall and severe weather based on the tilt of closed low

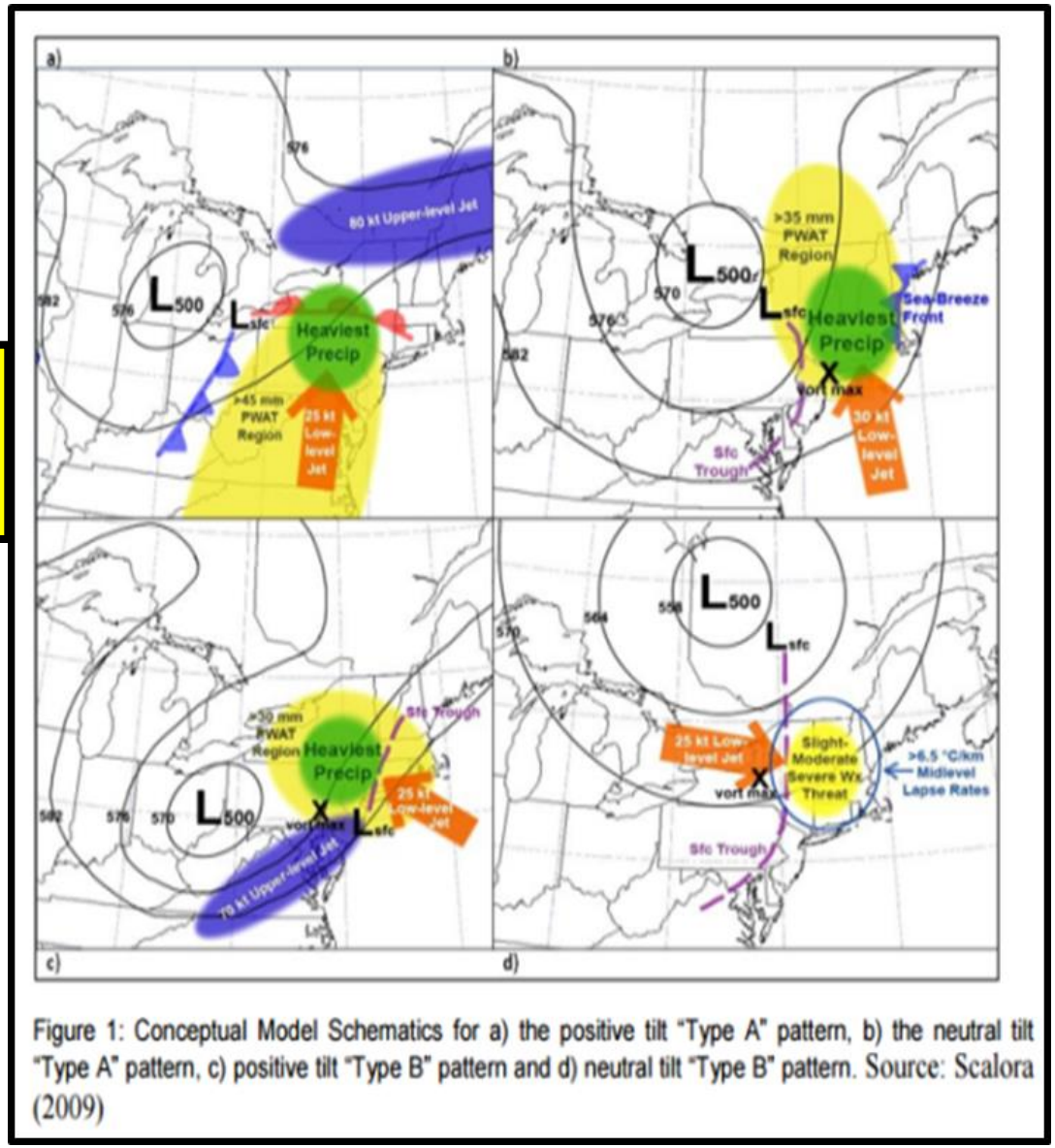


Figure 1: Conceptual Model Schematics for a) the positive tilt "Type A" pattern, b) the neutral tilt "Type A" pattern, c) positive tilt "Type B" pattern and d) neutral tilt "Type B" pattern. Source: Scalora (2009)

AFD Examples: Cool Season Wind and Warm Closed Lows

FXUS61 KALY 061930
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
330 PM EDT Tue Oct 6 2020

.SHORT TERM /WEDNESDAY THROUGH THURSDAY NIGHT/...
Even in the absence of convective cells, deep mixing along/behind the front into a layer of ~50 kt winds, along with strong cold advection promoting downward momentum transport, will support a strong synoptic wind threat. **Cross section analysis shows potential temperature decreasing with height along with a dry air intrusion at 700-500 mb, both of which have been shown by CSTAR research to enhance downward momentum transport, especially in the presence of convection.** Leafed-out trees will present more of a tree-fall hazard compared with a similar event in the winter. Some limiting factors to a more widespread/greater magnitude high wind event are potential for clouds to inhibit mixing depths behind the front over the high terrain, somewhat limited time behind the frontal boundary for diurnal heating to deepen the boundary layer, and weak convergence along the cold front. Advisory segmented in two to better delineate the wind threat along/behind the front.

SHORT TERM...Thompson

Area Forecast Discussion
National Weather Service Albany NY
432 AM EDT Sun Jul 16 2017

.SHORT TERM /6 PM THIS EVENING THROUGH TUESDAY NIGHT/...
Monday-Monday Night...Warm season closed lows are always challenging and the sensible weather associated with them. **CSTAR work on them indicates this has the potential to be a producer of heavy rain and perhaps some strong to severe thunderstorms. There are some of the characteristics of a Positive Tilt Type A conceptual model with PWATS increasing to greater than 1.5", though the orientation and position of the closed low is a little bit further north than the conceptual model and there is a lack of an upper jet entrance region nearby and strong low- level jet support.** Some cooling aloft and a short-wave rotating around the low will focus some convection in the afternoon, after some diurnal heating occurs. Some morning clouds may initially inhibit quick convective development, but dewpts increasing well into the 60s with SBCAPEs of 1000-2000 J/kg on the NAM, and 1000-2000+ J/kg on the GFS coupled with respectable mid-level lapse rates in the 6.5-7C/km range and 20-30 kt 0-6 km bulk shear should support some loosely organized multi-cells. The main threat for any severe thunderstorms in the afternoon into the early evening would be damaging winds and marginal 1" hail. The Marginal Risk still looks good from SPC. We have added gusty winds and heavy rain in the grids for now.

SHORT TERM...Wasula

Appalachian Lee Troughs (Thompson 2012)

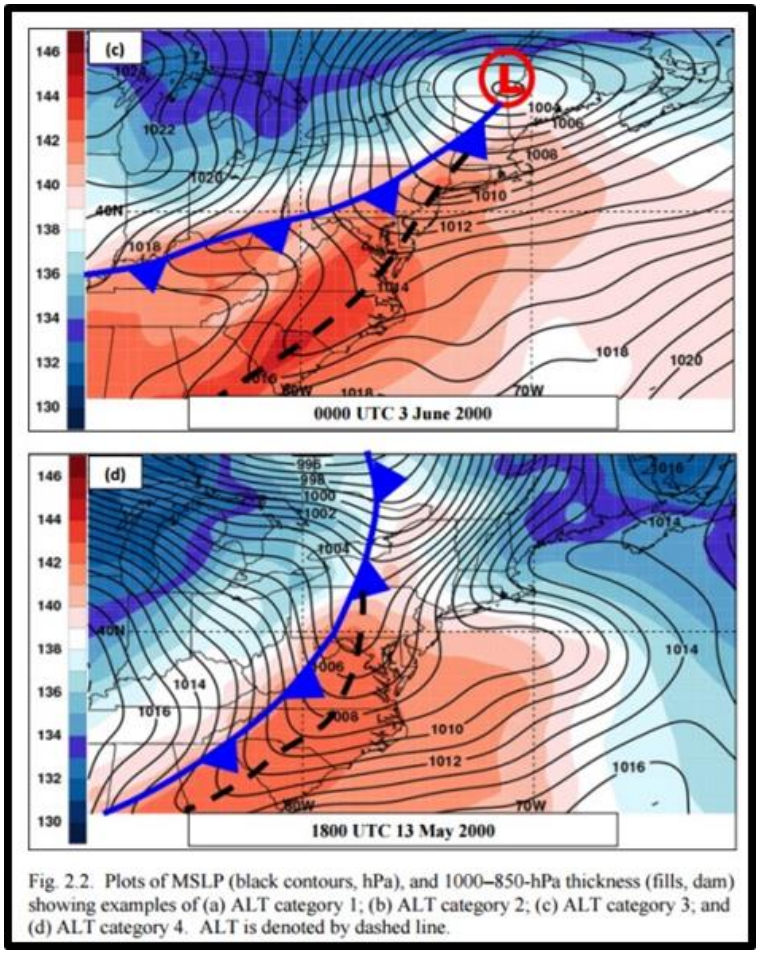


Fig. 2.2. Plots of MSLP (black contours, hPa), and 1000–850-hPa thickness (fills, dam) showing examples of (a) ALT category 1; (b) ALT category 2; (c) ALT category 3; and (d) ALT category 4. ALT is denoted by dashed line.

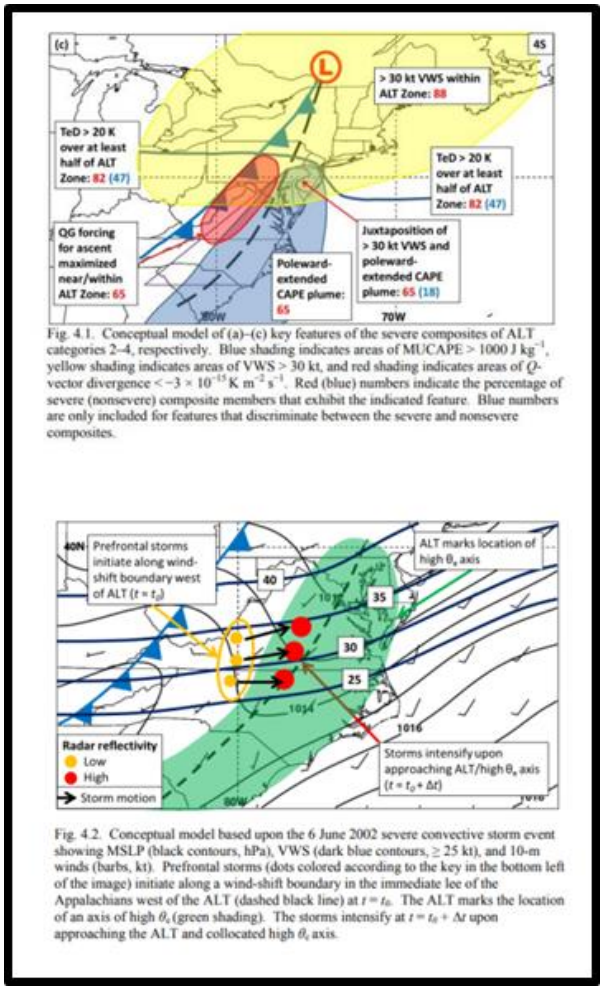
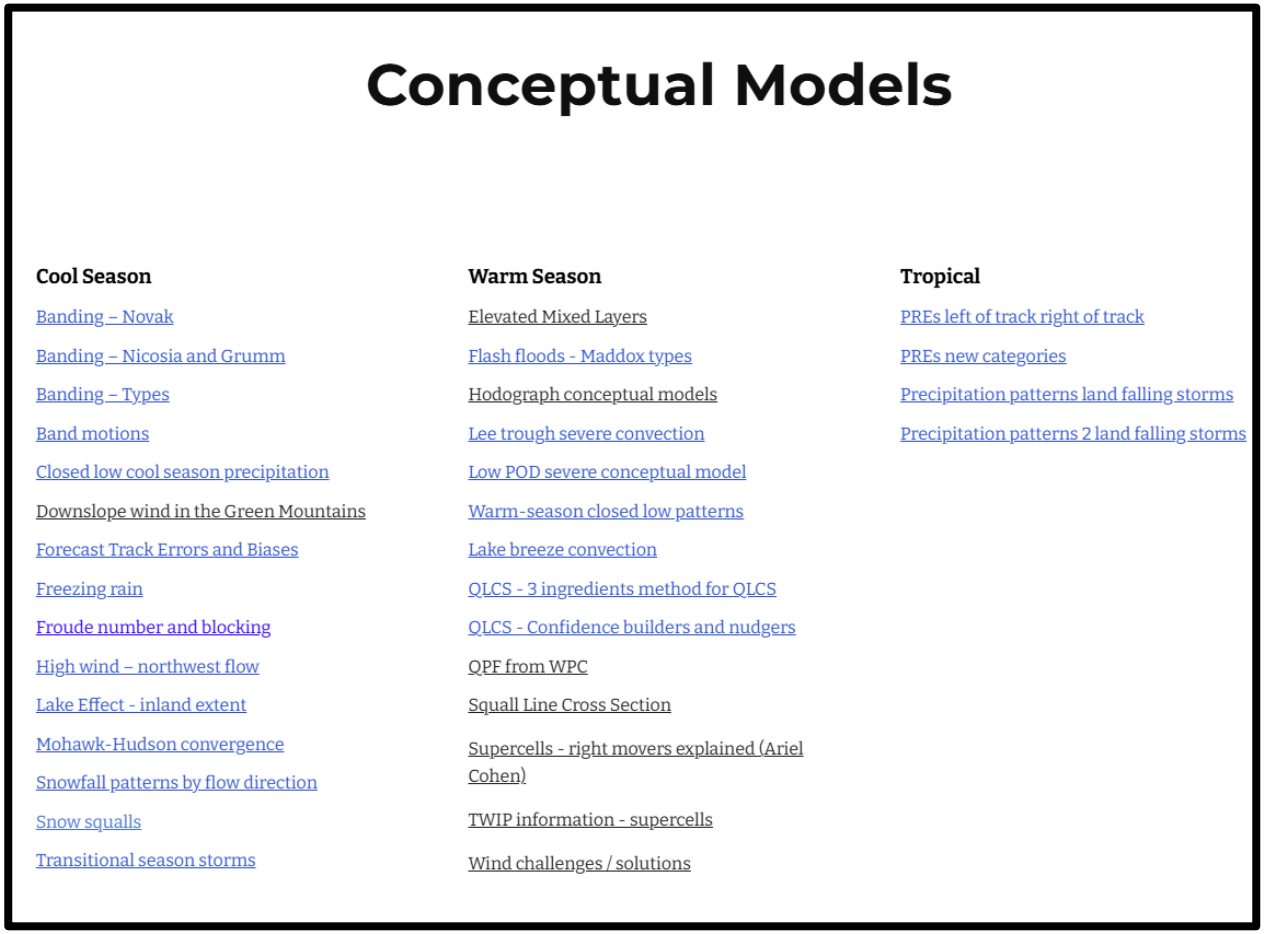


Fig. 4.1. Conceptual model of (a)–(c) key features of the severe composites of ALT categories 2–4, respectively. Blue shading indicates areas of MUCAPE > 1000 J kg^{-1}, yellow shading indicates areas of VWS > 30 kt, and red shading indicates areas of Q-vector divergence $< -3 \times 10^{-15}$ K m^{-2} s^{-1}. Red (blue) numbers indicate the percentage of severe (nonsevere) composite members that exhibit the indicated feature. Blue numbers are only included for features that discriminate between the severe and nonsevere composites.

Fig. 4.2. Conceptual model based upon the 6 June 2002 severe convective storm event showing MSLP (black contours, hPa), VWS (dark blue contours, ≥ 25 kt), and 10-m winds (barbs, kt). Prefrontal storms (dots colored according to the key in the bottom left of the image) initiate along a wind-shift boundary in the immediate lee of the Appalachians west of the ALT (dashed black line) at $t = t_0$. The ALT marks the location of an axis of high θ_e (green shading). The storms intensify at $t = t_0 + \Delta t$ upon approaching the ALT and collocated high θ_e axis.

R20 -> Conceptual Model Catalog

- NOAA V-lab -> UAlbany CSTAR page (one pagers, conceptual models, Master Thesis publications & publications)
- NWS ALY Google Sites: Conceptual Model Catalog



Conceptual Models

Cool Season

Banding – Novak
Banding – Nicosia and Grumm
Banding – Types
Band motions
Closed low cool season precipitation
Downslope wind in the Green Mountains
Forecast Track Errors and Biases
Freezing rain
Froude number and blocking
High wind – northwest flow
Lake Effect - inland extent
Mohawk-Hudson convergence
Snowfall patterns by flow direction
Snow squalls
Transitional season storms

Warm Season

Elevated Mixed Layers
Flash floods - Maddox types
Hodograph conceptual models
Lee trough severe convection
Low POD severe conceptual model
Warm-season closed low patterns
Lake breeze convection
QLCS - 3 ingredients method for QLCS
QLCS - Confidence builders and nudgers
QPF from WPC
Squall Line Cross Section
Supercells - right movers explained (Ariel Cohen)
TWIP information - supercells
Wind challenges / solutions

Tropical

PREs left of track right of track
PREs new categories
Precipitation patterns land falling storms
Precipitation patterns 2 land falling storms

Final Thoughts…Thank You to UAlbany!!!

Many thanks to Gene A., Warren S., Jeff W. and others too!!!