

ATMO 352
Severe Weather and Mesoscale Forecasting
Spring 2007

Laboratory #13: The 29 June 1998 Bow-echo/Derecho
And Today's Convective Outlook

Section 501, Thursday 04-26-07

DUE:

Part I. Wednesday, 05-02-07, by 5:00 PM. Hand in to either Kevin or Dr. Carey or, as a last resort, Dr. Carey's department mailbox in Rm 1204. Part II. By the end of today's lab.

Part I (35 points) The 29 June 1998 Bow-echo and Derecho over Iowa and Illinois

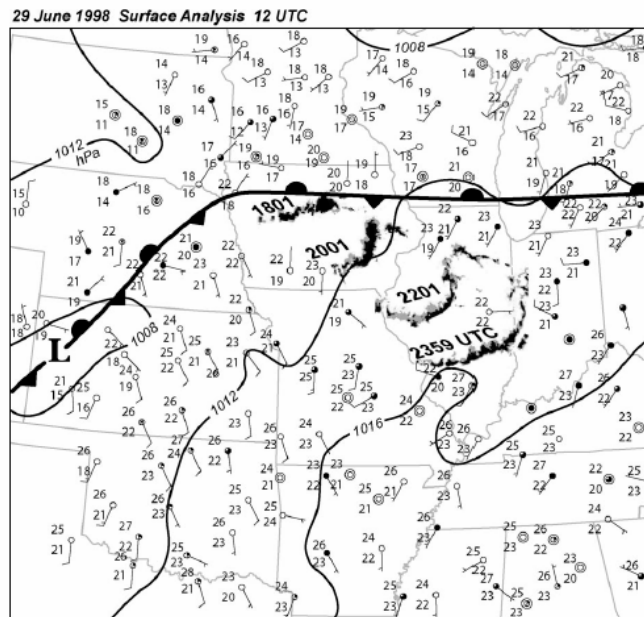


FIG. 1. Surface analysis on 29 Jun 1998 at 1200 UTC. Solid lines are isobars contoured every 4 hPa. Radar reflectivity data from the Davenport, IA, and Lincoln, IL, WSR-88Ds at 1801, 2001, 2201, and 2359 UTC on 29 Jun 1998 are superimposed on the surface data. Winds are shown in meters per second (half barb = 2.5 m s⁻¹; full barb = 5.0 m s⁻¹). Temperature and dewpoint are also shown in degrees Celsius.

Atkins et al. (2004)

On 29 June 1998, a quasi-linear convective system or bow-echo formed over Iowa around 1800 UTC near a stationary front (see Fig. 1 above from Atkins et al. 2004) and generated a long-lived, widespread wind event across Iowa and Illinois from 29/1800 UTC to 30/0000 UTC that met the formal derecho criteria of Johns and Hirt (1987). See Figure 6 below from Atkins et al. (2004) for a depiction of the evolution of the derecho event, including low-level radar reflectivity structure and distribution of *Storm Data* wind damage reports.

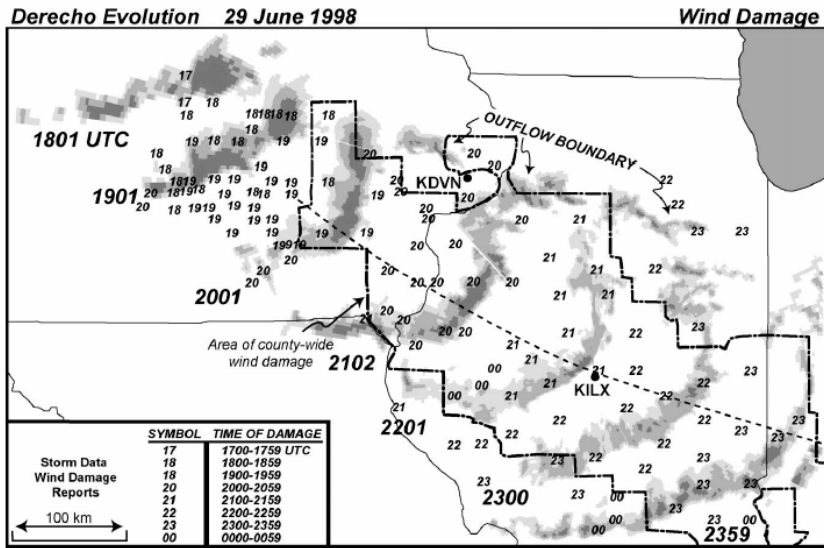


FIG. 6. Radar reflectivity (dBZ) at 1801, 1901, 2001, 2102, 2201, 2300, and 2359 UTC on 29 Jun 1998 is shown in gray along with locations of wind damage reports from *Storm Data*. The dashed-dotted line represents the area encompassing countywide wind damage reports. The long-dashed line represents the location of the primary bow echo apex.

Atkins et al. (2004)

In addition to sustained straight line winds, the bow-echo also produced multiple F0-F1 tornadoes during the derecho event. See Figure 7 below from Atkins et al. (2004) for a depiction of the *Storm Data* tornado locations and associated radar-detected meso-vortices during the evolution of the derecho.

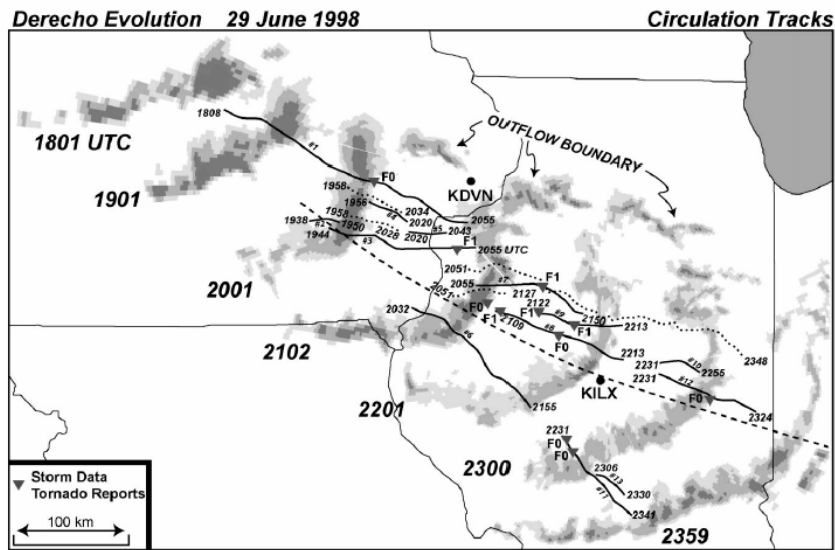


FIG. 7. As in Fig. 6, radar reflectivity is shown in gray. Solid black lines with start and end times represent the tracks of radar-detected circulations. The short-dashed lines represent the locations of radar-detected bookend vortices. The long-dashed line indicates the location of the primary bow echo apex. Tornado report locations and intensity from *Storm Data* are indicated with gray triangles.

Atkins et al. (2004)

The purpose of this lab is to 1) analyze the synoptic environment, including the 850/500 mb pattern, instability and wind/wind shear, associated with the 29 June 1998 derecho event and determine if it is consistent with the bow-echo and derecho conceptual models discussed earlier by Johns and Hirt (1987), Johns (1993), Weisman (1993), and Evans and Doswell (2001) and 2) investigate the detailed radar reflectivity and Doppler velocity structure of the bow-echo, low-level meso-vortices at the leading-edge likely associated with tornadic activity, and the mid-level book-end meso-vortices, likely associated with the rear inflow jet (RIJ) and strong surface winds.

1. (25 points) Upper-air analysis.

a. (15 points) 850 mb and 500 mb upper-air maps

Using garp (command `Bowecho first`) and the analysis period (00) of the RUC 29/1800 UTC model run, generate, print and hand in maps of the

1. 500 mb geopotential height, 500 mb wind barbs (kts)
2. 850 mb geopotential height, T_d every 4 °C, wind barbs (kts)
3. 850 mb geopotential height, T every 4 °C, wind barbs (kts)

As in earlier labs, please change the background color to conserve ink. Describe the synoptic pattern, focusing on ridge/trough positions, upper-level and low-level jets, and temperature and moisture advection at low-levels. What type of bow-echo derecho is this (serial or progressive)? Explain how the synoptic setup is similar/different than the conceptual models discussed earlier.

b. (10 points) Skew-T/Hodograph Analysis of Instability, Winds, and Shear

Using Nsharp (filter on `/h/metr352/cases/Iowa_bow_echo/upperair/`), plot and hand in the skew-t and hodograph for KILX at 29/1800 UTC and 30/0000 UTC using the *most unstable parcel*.

Summarize in a table the instability (LI, MUCAPE), shear (sfc-2km, sfc-6 km), and wind (sfc-6 km mean wind) for both KILX soundings. Note that the 30/00 UTC KILX sounding is truncated and will only provide sfc-2km shear. Discuss how the sounding is similar and different than the conceptual model for bow-echoes and derechos discussed earlier.

2. (10 points) WSR-88D KDVN Structure of the Bow-echo and Low-level Meso-vortices

Using the KDVN WSR-88D at 2019 UTC, locate the (lat/lon) the center of all the low-level meso-vortices (*hint*: there should be three) using Doppler radial velocity (V_r) (and possibly radar reflectivity) associated with tornadoes at 2019 UTC in the 0.5° or 1.5° tilts. Briefly describe the low level radar reflectivity and Doppler velocity structure of the bow echo at this time, putting the relationship of the low-level meso-vortices within the context of overall storm structure.

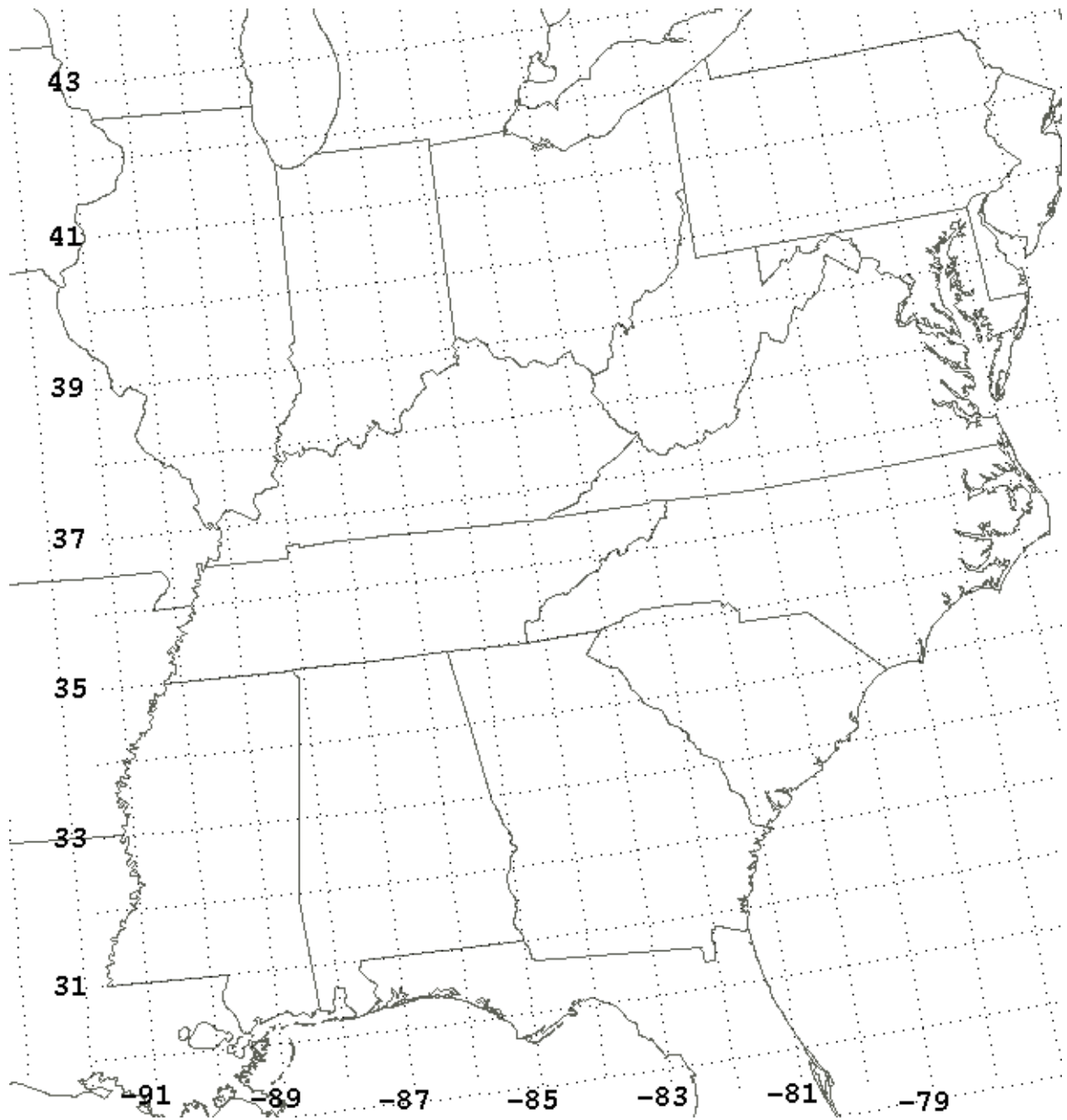
Final hint: Note that you might not always see both an inbound (negative) and outbound (positive) azimuthal couplet in ground relative V_r . You would need to subtract out storm motion to be assured of seeing the couplet. With ground relative V_r , there might only be an inbound (or outbound) maximum in azimuth that implies cyclonic rotation. Of course, sometimes there is a strong inbound and outbound ground relative V_r couplet in azimuth.

Part II, The Current Day I Convective Outlook - Team Forecasting Exercise (35 points)

1. (10 points) **Team Forecasting Exercise:** For the current DAY 1 situation, use the map below (next page) to provide your forecast of severe weather. In the area identified during lab, mark any 1° X 1° box in which you believe that *severe* weather will occur during the forecast period (i.e., about 1 hour after end of lab to the end of the DAY 1 forecast period or 2230 UTC to 1200 UTC next day). Also write the **number** of forecast boxes in which you expect severe weather to occur (i.e., count your marks). Hand in one team forecast.

Your team forecast, along with the current SPC Day 1 convective outlook, will be skill scored against preliminary severe storm reports from SPC. Any team that beats SPC's skill score automatically gets 14 points (i.e., 4 bonus points for this question). Otherwise, the top ranked team receives 10 points, the 2nd place team receives 8.5 points, the 3rd place team receives 7 points, and the 4th place team receives 5.5 points.

2. (25 points) On the back of the forecast map, please write a succinct but complete summary (paragraph or bullet form is fine) of the forecast problem(s) of the day, including the synoptic-to-mesoscale features, forecast parameters, and/or physical processes that support your severe weather forecast above. Be **specific and quantitative** when you can (e.g., don't just say "high CAPE and high shear" – give some values with units!) Hand in the forecasting sheet with forecast summary by the end of the lab period.



FORECASTED SEVERE BOXES: _____