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Fig. 1.1. Topography and selected major cities of the mid-Atlantic.

Fig 1.2. Schematic diagram showing a lee trough developing via dynamical mechanisms. Isentropes (degrees K) are contoured in black. “L” represents the location of the lee trough [adapted from Martin (2006)].

Fig. 1.3. Schematic of a mechanism for altering the path of a cyclonic weather system (the “primary”) crossing the Appalachians. The Appalachians are represented by an ellipse. The solid lines with arrows represent the surface circulation of the primary, which moves due east along the dashed path. At location 1, the upper- and lower-tropospheric reflections of the primary are in phase. When the primary is between locations 1 and 2, increasing downsloping easterly flow causes surface pressure falls and vorticity production at point *A*, and the primary surface cyclone is deflected northward (upper-left dot-dashed line). Meanwhile, increasing downsloping westerly flow forces lee cyclogenesis at point *B*. Thereafter, the lee cyclone gradually comes into phase with the primary upper-tropospheric cyclone (lower-right dot-dashed line) [from O’Handley and Bosart (1996)].

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Fig. 1.8. Composite maps of days when convective frequency exceeded one standard deviation above the areal 12-yr mean over the region outlined by the box in (a). Composites show (a) 500-hPa geopotential height (contours, m) and absolute vorticity (shaded,  $10^{-5} \text{ s}^{-1}$ ); (b) 925-hPa equivalent potential temperature (shaded, K), winds (full barb =  $10 \text{ m s}^{-1}$ ), and geopotential height (contours, m); and (c) sea level pressure (contours, hPa), surface winds (full barb =  $10 \text{ m s}^{-1}$ ), and most unstable CAPE (shaded,  $\text{J kg}^{-1}$ ) calculated from the 30-hPa layer average with the highest equivalent potential temperature within 180 hPa of the surface [from Murray and Colle (2011)].

Fig. 2.1. Geographical areas over which the ALT identification algorithm was run. “Domain” refers to the area enclosed by the blue trapezoid, “Wind Zone” refers to the area enclosed by the red trapezoid, and “ALT Zone” refers to the area enclosed by the black trapezoid.

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. 2.3. The ALT Zone divided into sectors by latitude. Locations of major cities are indicated with black dots. Sounding locations are indicated with a red star.

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Fig. 3.2. Percentage of occurrence of ALTs during the climatology with respect to varying MSLP and thermal anomaly thresholds. Bubbles are sized proportionally to the percentage of ALT occurrence. Red boxes indicate the anomaly thresholds adopted to define ALTs and the percentage of occurrence of ALTs with respect to those thresholds.

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Fig. 3.11. Scatterplots of MUCAPE and VWS calculated at the location of the first daily storm report in the (a) South Sector, (b) Center Sector, and (c) South Sector. Red (blue) dots indicate days in which at least (less than) 5 active grid boxes occurred. Median MUCAPE and VWS for days in which at least (less than) 5 active grid boxes occurred are listed in red (blue) type. The black line was arbitrarily drawn to delineate MUCAPE/VWS phase-space in which first daily storm reports are rare. In the South, Center, and North Sectors, 1.8%, 0.9%, and 0% of days with storm reports had MUCAPE and VWS values located below the black line, respectively.

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Fig. 3.16. As in Fig. 3.15 but for ALT category 2S.

Fig. 3.17. As in Fig. 3.15 but for ALT category 3N.

Fig. 3.18. As in Fig. 3.15 but for ALT category 3S.

Fig. 3.19. As in Fig. 3.15 but for ALT category 4N.

Fig. 3.20. As in Fig. 3.15, but for ALT category 4S.

Fig. 3.21. Location of storm reports occurring from 0400 UTC 6 June to 0400 UTC 7 June 2002.

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Fig. 3.23. As in Fig. 3.22 except at 0000 UTC 7 June 2002.

Fig. 3.24. Radar reflectivity (dBZ) and surface observations of (counterclockwise from top right) abbreviated altimeter setting (hPa), temperature (°C), dewpoint (°C),  $\theta_e$  (K), and winds (barbs, kt) from 6 June 2002 at (a) 1700, (b), (c) 1800, (d) 1900, (e) 2000, (f), (g) 2100, (h) 2200, and (i) 2300 UTC; and from 7 June 2002 at (j), (k) 0000, and (l) 0100 UTC. Severe convective wind reports (blue dots), severe hail reports (green dots), and

tornado reports (red dots) occurring 0–59 min prior to the time of each image are shown. A manual analysis of altimeter setting (black contours), frontal position, and ALT position (dashed line) is shown in panels (b), (f), and (j). A manual analysis of  $\theta_e$  (black contours) is shown in panels (c), (g), and (k).

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Fig. 3.26. NOAA HYSPLIT 24-h backward parcel trajectories originating at 100 m AGL at 1700 UTC 6 June 2002. Red, blue, and yellow correspond to trajectories originating at  $36.0^\circ\text{N}$ ,  $37.4^\circ\text{N}$ , and  $38.8^\circ\text{N}$ , respectively.

Fig. 3.27. Skew  $T$ – $\log p$  diagram of temperature ( $^\circ\text{C}$ ), dewpoint ( $^\circ\text{C}$ ), and wind (barbs, kt) at 1200 UTC 6 June 2002 for (a) WAL and (b) IAD.

Fig. 3.28. As in Fig. 3.25a except at 0000 UTC 7 June 2002.

Fig. 3.29. Skew  $T$ – $\log p$  diagram of NARR-derived (a) temperature (black line,  $^\circ\text{C}$ ), dewpoint (red line,  $^\circ\text{C}$ ), and wind (barbs, kt) for FAF at 2100 UTC 6 June; (b) a conceptual model of an environment conducive to wet microbursts from Atkins and Wakimoto (1991) showing temperature (solid line,  $^\circ\text{C}$ ) and dewpoint (dashed line,  $^\circ\text{C}$ ). Panels (c) and (d) are the same as (a) and (b), respectively, except that they are  $\log p$  diagrams of the vertical profile of  $\theta_e$ .

Fig. 3.30. Meteogram from 1700 to 2200 UTC 6 June 2002 showing wind (barbs, kt), temperature (black line,  $^\circ\text{C}$ ), and dewpoint (red line,  $^\circ\text{C}$ ) at (a) FDK and (b) OMH. Red arrows correspond to the approximate tornado touchdown time for each station.

Fig. 3.31. Shows the stations between the prefrontal and alongfront convective storms that exhibited surface winds that backed from 2000 to 2100 UTC. Wind barbs (kt) at 2000 (2100) UTC plotted in red (blue).

Fig. 3.32. As in Fig. 3.29a but for (a) FDK and (b) OMH. Observed 2100 UTC surface winds are shown to the right of the NARR-derived winds.

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  $\text{MUCAPE} > 1000 \text{ J kg}^{-1}$ , yellow shading indicates areas of  $\text{VWS} > 30 \text{ kt}$ , and red shading indicates areas of  $Q$ -vector divergence  $< -3 \times 10^{-15} \text{ K m}^{-2} \text{ s}^{-1}$ . 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,  $\geq 25 \text{ kt}$ ), 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  $\theta_e$  (green shading). The storms intensify at  $t = t_0 + \Delta t$  upon approaching the ALT and collocated high  $\theta_e$  axis.