

## REFERENCES

- Agustí-Panareda, A., C. D. Thorncroft, G. C. Craig, and S. L. Gray, 2004: The extratropical transition of Hurricane Irene (1999): A potential vorticity perspective. *Quart. J. Roy. Meteor. Soc.*, **130**, 1047–1074.
- Atallah, E. H., and L. F. Bosart, 2003: The extratropical transition and precipitation distribution of Hurricane Floyd (1999). *Mon. Wea. Rev.*, **131**, 1063–1081.
- , ———, and A. R. Aiyyer, 2007: Precipitation distribution associated with landfalling tropical cyclones over the eastern United States. *Mon. Wea. Rev.*, **135**, 2185–2206.
- Augustine, J. A., and F. Caracena, 1994: Lower-tropospheric precursors to nocturnal MCS development over the central United States. *Wea. Forecasting*, **9**, 116–135.
- Beard, K. V., and H. T. Ochs III, 1993: Warm-rain initiation: An overview of microphysical mechanisms. *J. Appl. Meteor.*, **32**, 608–625.
- Bell, G. D., and L. F. Bosart, 1988: Appalachian cold-air damming. *Mon. Wea. Rev.*, **116**, 137–161.
- Benjamin, S. G., and Coauthors, 2002: RUC20 –The 20-km version of the Rapid Update Cycle. NWS Technical Procedures Bulletin 490, National Oceanic and Atmospheric Administration/National Weather Service, 30 pp.
- Bluestein, H. B., 1992: *Principles of Kinematics and Dynamics*. Vol. I. *Synoptic-Dynamic Meteorology in Midlatitudes*. Oxford University Press, 431 pp.
- Brennan, Michael J., Gary M. Lackmann, Kelly M. Mahoney, 2008: Potential vorticity (PV) thinking in operations: the utility of nonconservation. *Wea. Forecasting*, **23**, 168–182.

- Bonner, W. D., 1968: Climatology of the low-level jet. *Mon. Wea. Rev.*, **96**, 833–850.
- Bosart, L. F., 1975: New England coastal frontogenesis. *Quart. J. Roy. Meteor. Soc.*, **101**, 957–978.
- , and F. H. Carr, 1978: A case study of excessive rainfall centered around Wellsville, New York, 20–21 June 1972. *Mon. Wea. Rev.*, **106**, 348–362.
- , and G. M. Lackmann, 1995: Postlandfall tropical cyclone reintensification in a weakly baroclinic environment: A case study of Hurricane David (September 1979). *Mon. Wea. Rev.*, **123**, 3268–3291.
- , and D. B. Dean, 1991: The Agnes rainstorm of June 1972: Surface feature evolution culminating in inland storm redevelopment. *Wea. Forecasting*, **6**, 515–537.
- Brooks, H. E., and D. J. Stensrud, 2000: Climatology of heavy rain events in the United States from hourly precipitation observations. *Mon. Wea. Rev.*, **128**, 1194–1201.
- Caracena, F., R. A. Maddox, L. R. Hoxit, and C. F. Chappell, 1979: Mesoanalysis of the Big Thompson storm. *Mon. Wea. Rev.*, **107**, 1–17.
- Carbone, R. E., J. D. Tuttle, D. A. Ahijevych, and S. B. Trier, 2002: Inferences of predictability associated with warm season precipitation episodes. *J. Atmos. Sci.*, **59**:2033–2056.
- Carr, F. H., and L. F. Bosart, 1978: A diagnostic evaluation of rainfall predictability for Tropical Storm Agnes, June 1972. *Mon. Wea. Rev.*, **106**, 363–374.
- Chappell, C. F., 1986: Quasi-stationary convective events. *Mesoscale Meteorology and Forecasting*, P. S. Ray, Ed. Amer. Meteor. Soc., 289–309.
- Colle, B. A., 2003: Numerical simulations of the extratropical transition of Floyd (1999):

- Structural evolution and responsible mechanisms for heavy rainfall over the northeast United States. *Mon. Wea. Rev.*, **131**, 2905–2926.
- Corbosiero, K. L., M. J. Dickinson, and L. F. Bosart, 2009: The contribution of eastern North Pacific tropical cyclones to the rainfall climatology of the southwest United States. *Mon. Wea. Rev.*, **137**, 2415–2435.
- Cote, M. R., 2007: Predecessor rain events in advance of tropical cyclones. M.S. Thesis, Department of Atmospheric and Environmental Sciences, University at Albany, State University of New York, 200 pp. [Available online at [http://cstar.cestm.albany.edu/CAP\\_Projects/Project10/index.htm](http://cstar.cestm.albany.edu/CAP_Projects/Project10/index.htm).]
- Davis, C. A., 1992: Piecewise Potential Vorticity Inversion. *J. Atmos. Sci.*, **49**, 1397-1411.
- , K. W. Manning, R. E. Carbone, S. B. Trier, and J. D. Tuttle, 2003: Coherence of warm-season continental rainfall in numerical weather prediction models. *Mon. Wea. Rev.*, **131**:2667–2679.
- Davis, R. S., 2001: Flash flood forecast and detection methods. *Severe Convective Storms, Meteor. Monogr.*, No. 50, Amer. Meteor. Soc., 481–525.
- DiMego, G. J., and L. F. Bosart, 1982a: The transformation of tropical storm Agnes into an extratropical cyclone. Part I: The observed fields and vertical motion computations. *Mon. Wea. Rev.*, **110**, 385–411.
- , and ———, 1982b: The transformation of tropical storm Agnes into an extratropical cyclone. Part II: Moisture, vorticity and kinetic energy budgets. *Mon. Wea. Rev.*, **110**, 412–433.

- Doswell, C. A., III, 1987: The distinction between large-scale and mesoscale contribution to severe convection: A case study example. *Wea. Forecasting*, **2**, 3–16.
- , H. E. Brooks, and R. A. Maddox, 1996: Flash flood forecasting: An ingredients-based methodology. *Wea. Forecasting*, **11**, 560–581.
- , C. Ramis, R. Romero and S. Alonso (1998): A diagnostic study of three heavy precipitation episodes in the western Mediterranean. *Wea. Forecasting*, **13**, 102–124.
- , and L. F. Bosart, 2001: Extratropical synoptic-scale processes and severe convection. *Severe Convective Storms, Meteor. Monogr.*, No. 50, Amer. Meteor. Soc., 27–69.
- Eliassen, A., 1962: On the vertical circulation in frontal zones. *Geophys. Publ.*, **24**, 147–160.
- Farfán, L. M. and I. Fogel, 2007: Influence of tropical cyclones on humidity patterns over southern Baja California, Mexico. *Mon. Wea. Rev.*, **135**, 1208–1224.
- Funk, T. W., 1991: Forecasting techniques utilized by the forecast branch of the National Meteorological Center during a major convective rainfall event. *Wea. Forecasting*, **6**, 548–564.
- , 2003: Heavy convective rainfall forecasting: A comprehensive look at parameters, processes, patterns, and rules of thumb. Training document, National Weather Service weather forecast office, Louisville, KY. [Available online at <http://www.crh.noaa.gov/lmk/soo/docu/>.]
- Galarneau, T. J., Jr., L. F. Bosart, and R. S. Schumacher, 2010: Predecessor rain events ahead of tropical cyclones. *Mon. Wea. Rev.*, In press.

- Glass, F. H., D. L. Ferry, J. T. Moore, and S. M. Nolan, 1995: Characteristics of heavy convective rainfall events across the mid-Mississippi valley during the warm season: Meteorological conditions and a conceptual model. Preprints, *14th Conf. on Weather Analysis and Forecasting*, Dallas, TX, Amer. Meteor. Soc., 34–41.
- Hakim, G. J., and D. Keyser, 2001: Canonical frontal circulation patterns in terms of Green's functions for the Sawyer–Eliassen equation. *Quart. J. Roy. Meteor. Soc.*, **127**, 1795–1814.
- Harr, P. A., and R. L. Elsberry, 2000: Extratropical transition of tropical cyclones over the western north Pacific. Part I: Evolution of structural characteristics during the transition process. *Mon. Wea. Rev.*, **128**, 2613–2633.
- , ———, and T. F. Hogan, 2000: Extratropical transition of tropical cyclones over the western north Pacific. Part II: The impact of midlatitude circulation characteristics. *Mon. Wea. Rev.*, **128**, 2634–2653.
- Higgins, R. W., W. Shi, E. Yarosh, and R. Joyce, 2000: Improved United States Precipitation Quality Control System and Analysis. [Available online at [http://www.cpc.ncep.noaa.gov/research\\_papers/ncep\\_cpc\\_atlas/7/toc.html](http://www.cpc.ncep.noaa.gov/research_papers/ncep_cpc_atlas/7/toc.html)].
- Higgins, R. W. and W. Shi, 2005: Relationships between Gulf of California moisture surges and tropical cyclones in the eastern Pacific basin. *J. Climate*, **18**, 4601–4620.
- Hoskins, B. J., I. Draghici, and H. C. Davies, 1978: A new look at the omega equation. *Quart. J. Roy. Meteor. Soc.*, **104**, 31–38.
- , M. McIntyre, and A. W. Robertson, 1985: On the use and significance of isentropic potential vorticity maps. *Quart. J. Roy. Meteor. Soc.*, **111**:877–946.

- Houze, R. A., Jr., B. F. Smull, and P. Dodge, 1990: Mesoscale organization of springtime rainstorms in Oklahoma. *Mon. Wea. Rev.*, **118**, 613–654.
- , R. A., Jr., 2004: Mesoscale convective systems. *Rev. Geophys.*, **42**, 10.1029/2004RG000150, 43 pp.
- Hsie, E-Y., R. A. Anthes, and D. Keyser, 1984: Numerical simulation of frontogenesis in a moist atmosphere. *J. Atmos. Sci.*, **41**, 2581–2594.
- Jankov, I. and W. A. Gallus, 2004: MCS rainfall forecast accuracy as a function of large-scale forcing. *Wea. Forecasting*, **19**:428–439.
- Jones, S. C., and Coauthors, 2003: The extratropical transition of tropical cyclones: Forecast challenges, current understanding, and future directions. *Wea. Forecasting*, **18**, 1052–1092.
- Junker, N. W., R. S. Schneider, and S. L. Fauver, 1999: A study of heavy rainfall events during the Great Midwest Flood of 1993. *Wea. Forecasting*, **14**, 701–712.
- Kalnay, E., and Coauthors, 1996: The NCEP/NCAR 40-Year Reanalysis Project. *Bull. Amer. Meteor. Soc.*, **77**, 437–472.
- Keyser, D., M. J. Reeder, and R. J. Reed, 1988: A generalization of Petterssen's frontogenesis function and its relation to the forcing of vertical motion. *Mon. Wea. Rev.*, **116**, 762–780.
- , B. D. Schmidt, and D. G. Duffy, 1992: Quasigeostrophic vertical motions diagnosed from along- and cross-isentrope components of the Q vector. *Mon. Wea. Rev.*, **120**, 731–741.
- , 1999: On the representation and diagnosis of frontal circulations in two and three dimensions. *The Life Cycles of Extratropical Cyclones*, M. A. Shapiro and S.

- Gronas, Eds., Amer. Meteor. Soc., 239-264.
- Keyser, D. A. and D. R. Johnson, 1984: Effects of diabatic heating on the ageostrophic circulation of an upper tropospheric jet streak. *Mon. Wea. Rev.*, **112**, 1709–1724.
- Kistler, R., and Coauthors, 2001: The NCEP/NCAR 50-year reanalysis: Monthly means CD-ROM and documentation. *Bull. Amer. Meteor. Soc.*, **82**, 247–267.
- Klein, J. R., 2007: Mesoscale precipitation structures accompanying landfalling and transitioning tropical cyclones over the northeast United States. M.S. Thesis, Department of Atmospheric and Environmental Sciences, University at Albany, State University of New York, 139 pp. [Available online at [http://cstar.cestm.albany.edu/CAP\\_Projects/Project10/index.htm](http://cstar.cestm.albany.edu/CAP_Projects/Project10/index.htm).]
- Klein, P. M., P. A. Harr, and R. L. Elsberry, 2000: Extratropical transition of western north Pacific tropical cyclones: An overview and conceptual model of the transformation stage. *Wea. and Forecasting*, **15**, 373–395.
- , ——, and ——, 2002: Extratropical transition of western north Pacific tropical cyclones: Midlatitude and tropical cyclone contributions to reintensification. *Mon. Wea. Rev.*, **130**, 2240–2259.
- Konrad, C. E., II, 1997: Synoptic-scale features associated with warm season heavy rainfall over the interior southeastern United States. *Wea. Forecasting*, **12**, 557–571.
- LaPenta, K. D., and Coauthors, 1995: The challenge of forecasting heavy rain and flooding throughout the eastern region of the National Weather Service. Part I: Characteristics and events. *Wea. Forecasting*, **10**, 78–90.

- Lin, Y. L., S. Chiao, T. A. Wang, M. L. Kaplan, and R. P. Weglarz, 2001: Some common ingredients for heavy orographic rainfall. *Wea. Forecasting*, **16**, 633–660.
- Maddox, R. A., 1980: Mesoscale convective complexes. *Bull. Amer. Meteor. Soc.*, **60**, 115–123.
- , 1983: Large-scale meteorological conditions associated with midlatitude mesoscale convective complexes. *Mon. Wea. Rev.*, **111**, 1475–1493.
- , L. R. Hoxit, C. F. Chappell, and F. Caracena, 1978: Comparison of meteorological aspects of the Big Thompson and Rapid City flash floods. *Mon. Wea. Rev.*, **106**, 375–389.
- , C. F. Chappell, and L. R. Hoxit, 1979: Synoptic and meso- scale aspects of flash flood events. *Bull. Amer. Meteor. Soc.*, **60**, 115–123.
- , D. J. Perkey, and J. M. Fritsch, 1981: Evolution of upper tropospheric features during the development of a mesoscale convective complex. *J. Atmos. Sci.*, **38**, 1664–1674.
- Market, P., S. Allen, R. Scofield, R. Kuligowski, and A. Gruber, 2003: Precipitation efficiency of warm-season Midwestern mesoscale convective systems. *Wea. Forecasting*, **18**, 1273–1285.
- Martin, J. E., 2006a: *Mid-latitude Atmospheric Dynamics: A First Course*. John Wiley and Sons, 336 pp.
- , 2006b: The role of shearwise and transverse quasigeostrophic vertical motions in the midlatitude cyclone life cycle. *Mon. Wea. Rev.*, **134**, 1174–1193.

- McDonald, B.E., and M.N. Baker, 2001: The NWS National QPF Verification Program. COMET RFC/HPC Hydrometeorology course 02-1. [Available online at [http://www.hpc.ncep.noaa.gov/npvu/confpres/hydromet02/hydromet02\\_1.pdf](http://www.hpc.ncep.noaa.gov/npvu/confpres/hydromet02/hydromet02_1.pdf)].
- McTaggart-Cowan, R., J. R. Gyakum, M. K. Yau, 2001: Sensitivity Testing of Extratropical Transitions Using Potential Vorticity Inversions to Modify Initial Conditions: Hurricane Earl Case Study. *Mon. Wea. Rev.*, **129**, 1617-1636.
- Moore, J. T., F. H. Glass, C. E. Graves, S. M. Rochette, and M. J. Singer, 2003: The environment of warm-season elevated thunderstorms associated with heavy rainfall over the central United States. *Wea. Forecasting*, **18**, 861–878.
- Moore, J. T. and G. E. VanKowen, 1992: The effect of jet-streak curvature on kinematic fields. *Mon. Wea. Rev.*, **120**, 2429–2441.
- Morgan, M. C. and J. W. Nielsen-Gammon, 1998: Using tropopause maps to diagnose midlatitude weather systems. *Mon. Wea. Rev.*, **126**, 2555–2579.
- O'Handley, C., and L. F. Bosart, **1996**: The impact of the Appalachian mountains on cyclonic weather systems Part I: A climatology. *Mon. Wea. Rev.*, **124**, 1353–1373.
- Parker, M. D., 2007: Simulated convective lines with parallel precipitation. Part I: Basic structures. *J. Atmos. Sci.*, **64**, 267–288.
- Petterssen, S., 1936: Contribution to the theory of frontogenesis. *Geofys. Publ.*, **11**(6), 1–27.
- , 1956: *Weather Analysis and Forecasting, Vol. 1, Motion and Motion Systems*. 2<sup>nd</sup> ed. McGraw-Hill 428 pp.
- Pierce, C. H., 1939: The meteorological history of the New England hurricane of Sept. 21, 1938. *Mon. Wea. Rev.*, **67**, 237–285.

- Pontrelli, M. D., G. Bryan, and J. M. Fritsch, 1999: The Madison County, Virginia, flash flood of 27 June 1995. *Wea. Forecasting*, **14**, 384–404.
- Pyle, M. E., D. Keyser, and L. F. Bosart, 2004: A diagnostic study of jet streaks: Kinematic signatures and relationship to coherent tropopause disturbances. *Mon. Wea. Rev.*, **132**, 297–319.
- Ralph, F. M., P. J. Neiman, and R. Rotunno, 2005: Dropsonde observations in low-level jets over the northeastern Pacific Ocean from CALJET-1998 and PACJET-2001: Mean vertical-profile and atmospheric-river characteristics. *Mon. Wea. Rev.*, **133**, 889–910.
- Riemer, M., S. C. Jones, and C. A. Davis, 2008: The impact of extratropical transition on the downstream flow: An idealised modelling study with a straight jet. *Quart. J. Roy. Meteor. Soc.*, **134**, 69–91.
- Romero, R., C. A. Doswell III, and C. Ramis, 2000: Mesoscale numerical study of two cases of long-lived quasistationary convective systems over eastern Spain. *Mon. Wea. Rev.*, **128**, 3731–3751.
- Schumacher, P. N., D. J. Knight, and L. F. Bosart, 1996: Frontal interaction with the Appalachian Mountains. Part I: A climatology. *Mon. Wea. Rev.*, **124**, 2453–2468.
- Schumacher, R. S., and R. H. Johnson, 2005: Organization and environmental properties of extreme-rain-producing mesoscale convective systems. *Mon. Wea. Rev.*, **133**, 961–976.
- , and ———, 2006: Characteristics of U.S. extreme rain events during 1999–2003. *Wea. Forecasting*, **21**, 69–85.
- , and ———, 2008: Mesoscale processes contributing to extreme rainfall in a

- midlatitude warm-season flash flood. *Mon. Wea. Rev.*, **136**, 3964–3986.
- , and ———, 2009: Quasi-stationary, extreme-rain-producing convective systems associated with midlevel cyclonic circulations. *Wea. Forecasting*, **24**, 555–574.
- Schwarz, F. K., 1970: The unprecedented rains in Virginia associated with the remnants of Hurricane Camille. *Mon. Wea. Rev.*, **98**, 851–859.
- Sinclair, M. R., 1993: A diagnostic study of the extratropical precipitation resulting from Tropical Cyclone Bola. *Mon. Wea. Rev.*, **121**, 2690–2707.
- Srock, A. F., and L. F. Bosart, 2009: Heavy precipitation associated with southern Appalachian cold-air damming and Carolina coastal frontogenesis in advance of weak landfalling Tropical Storm Marco (1990). *Mon. Wea. Rev.*, **137**, 2448–2470.
- Svoma, B. M., 2010: The influence of monsoonal gulf surges on precipitation and diurnal precipitation patterns in central Arizona. *Wea. Forecasting*, **25**, 281–289.
- Trenberth, K. E., 1978: On the interpretation of the diagnostic quasi-geostrophic omega equation. *Mon. Wea. Rev.*, **106**, 131–137.
- Trier, S. B. and D. B. Parsons, 1993: Evolution of environmental conditions preceding the development of a nocturnal mesoscale convective complex. *Mon. Wea. Rev.*, **121**, 1078–1098.
- , C. A. Davis, D. A. Ahijevych, M. L. Weisman, and G. H. Bryan, 2006: Mechanisms supporting long-lived episodes of propagating nocturnal convection within a 7-day WRF model simulation. *J. Atmos. Sci.*, **63**, 2437–2461.
- , and R. D. Sharman, 2009: Convection-permitting simulations of the environment supporting widespread turbulence within the upper-level outflow of an MCS. *Mon. Wea. Rev.*, **137**, 1972–1990.

- Tuttle, J. D. and C. A. Davis, 2006: Corridors of warm season precipitation in the central United States. *Mon. Wea. Rev.*, **134**, 2297–2317.
- Uccellini, L. W., and D. R. Johnson, 1979: The coupling of upper and lower tropospheric jet streaks and implications for the development of severe convective storms. *Mon. Wea. Rev.*, **107**, 682–703.
- , 1980: On the role of upper tropospheric jet streaks and leeside cyclogenesis in the development of low-level jets in the Great Plains. *Mon. Wea. Rev.*, **108**, 1689–1696.
- Wang, Yo., Wang, Yu., and H. Fudeyasu, 2009: Effect of Typhoon Songda (2004) on remote heavy rainfall in Japan. *Mon. Wea. Rev.*, **137**, 3699–3716.
- Wu, Chun-Chieh, Kerry A. Emanuel, 1993: Interaction of a baroclinic vortex with background shear: application to hurricane movement. *J. Atmos. Sci.*, **50**, 62-76.