

Mesoscale Convective Systems



Photo: C. Godfrey

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Mesoscale Convective Systems

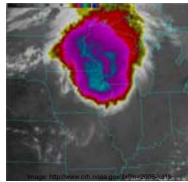
- Definition
 - A system of thunderstorms that produces a contiguous horizontal precipitation area on the order of 100 km or more in at least one direction
- Special cases of mesoscale convective systems
 - Mesoscale convective complex (nearly circular)
 - Squall line (larger length-to-width ratio)



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Mesoscale Convective Complex (MCC)

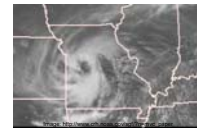
- Nearly circular (eccentricity ≥ 0.7) cloud shield with
 - Continuous cloud-top temperature $\leq -32^{\circ}\text{C}$ with area $\geq 100,000 \text{ km}^2$
 - Interior cloud-top temperature $\leq -52^{\circ}\text{C}$ with area $\geq 50,000 \text{ km}^2$
- Lasts ≥ 6 hours
- An MCC can persist for days!



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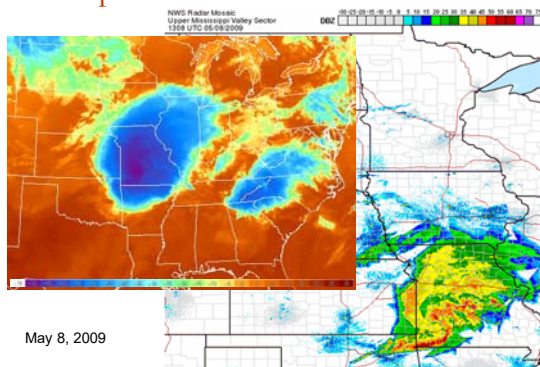
Mesoscale Convective Vortex (MCV)

- Latent heat release within an MCC can produce a mesoscale low pressure
- Embedded mid-level cyclonic circulation is a mesoscale convective vortex (MCV)
- Persists long after parent convective system dissipates
- MCV may support new storms for several days



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Example: MCC with embedded MCV



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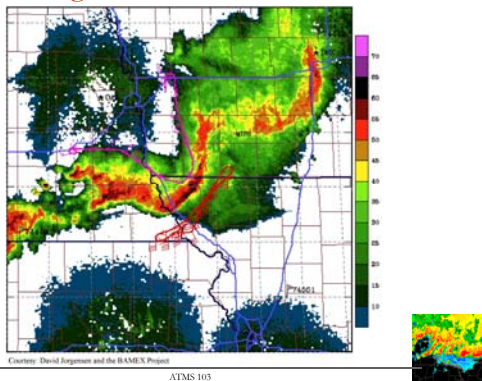
Squall Line

- An organized line of convection
 - Small width (5–15 km), long length (100–1000 km)
 - Leading edge of MCC or frontal squall line
- Usually occurs during transition months
 - Spring and fall, but can occur year round
- Lifting mechanism for frontal squall line is a cold front or dryline
- Occurs with strong speed shear but little directional shear

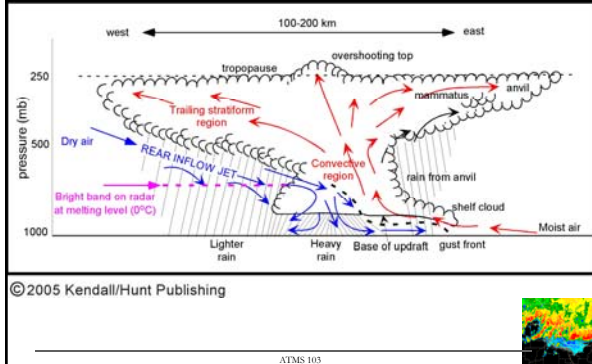


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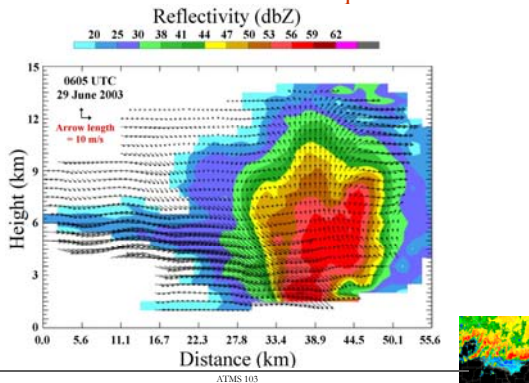
Radar Image of an MCS



MCS Squall Line Cross-Section



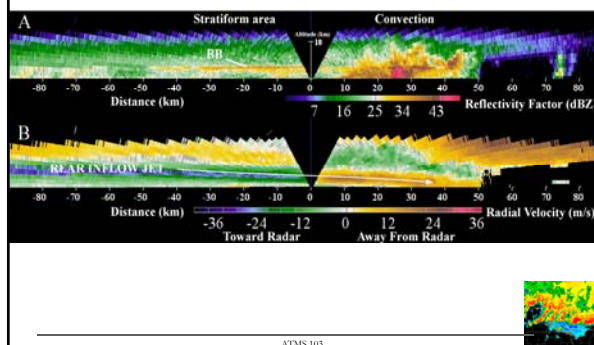
Radar Cross-Section of a Squall Line



Stratiform Region of an MCS

- Steady light, moderate, or heavy rain behind a squall line
- Generally not a severe threat, but flooding could be problematic!
- Doesn't occur with all squall lines

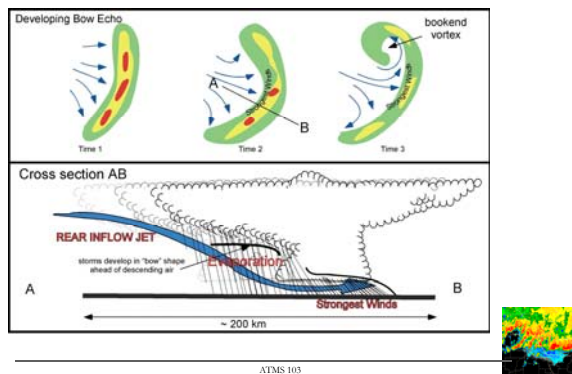
Radar Cross-Section of a Squall Line



Bow Echo

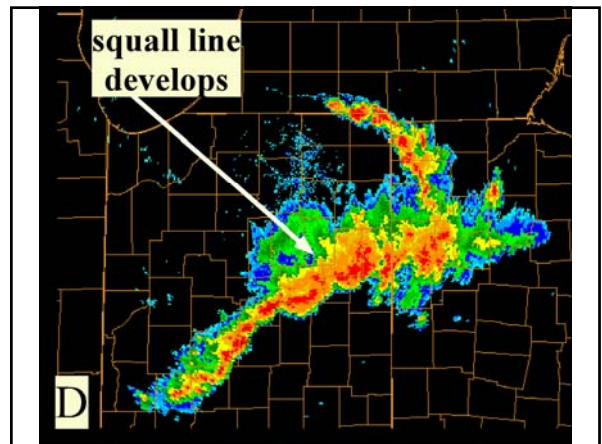
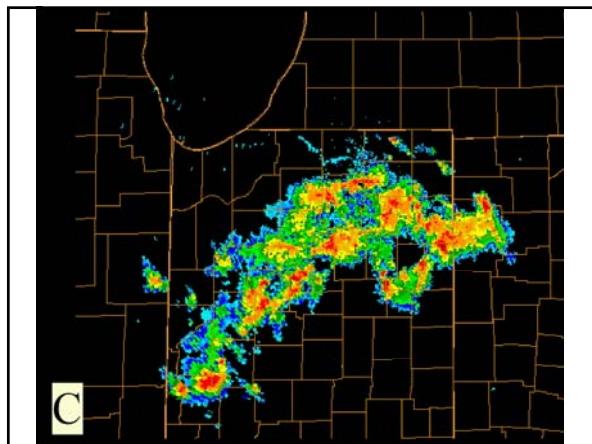
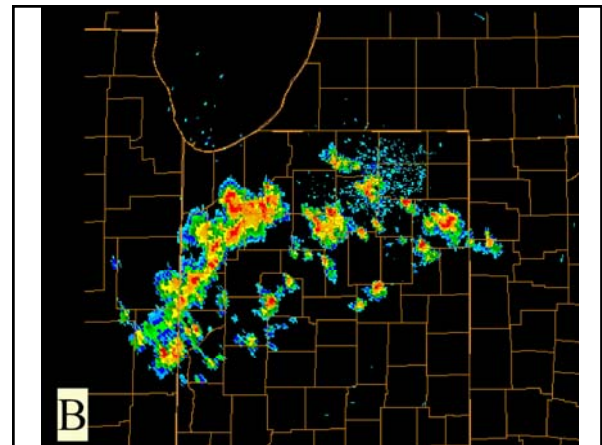
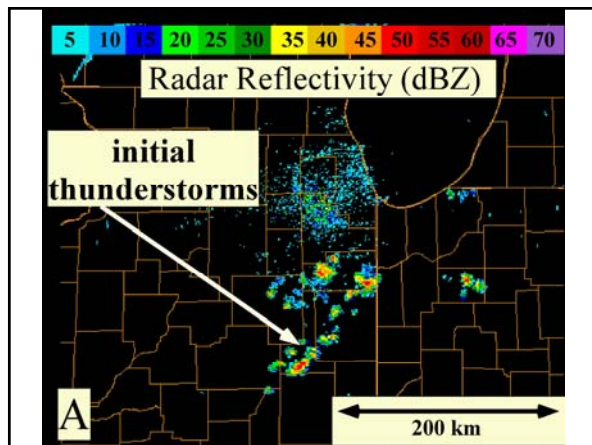
- Usually an area of severe straight-line winds that "bows" outward from other squall line segments
- Evaporation causes strong rear inflow jet
- Rear inflow jet transfers strong upper-level winds to the surface, causing wind damage

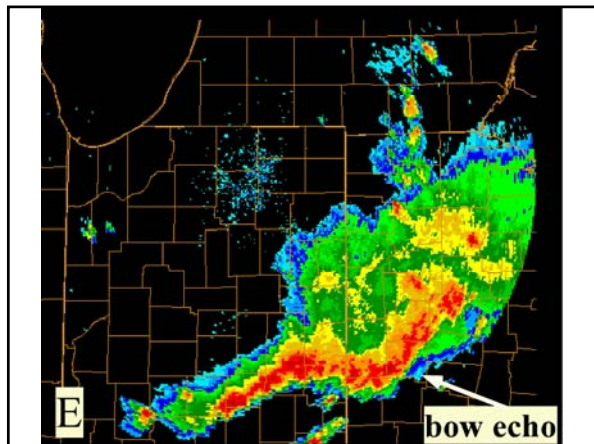
Bow Echo



Derecho

- A widespread, convectively induced straight-line wind storm
- Associated with bow echoes





Gust Fronts

- A gust front is the downdraft spreading out after hitting the ground
- Gust front surges out from thunderstorm
- Forms shelf cloud (also arcus; attached to thunderstorm) or roll cloud (detached from thunderstorm) as warm, moist air is pushed upward



Shelf Cloud Along Leading Edge of Gust Front



Shelf Cloud



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Shelf Cloud



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Shelf Cloud



Gust Front + Lots of Dust = Haboob



Looking West



Looking East



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MCS Examples

- August 26, 2001
- September 8, 2001
- September 18, 2001



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