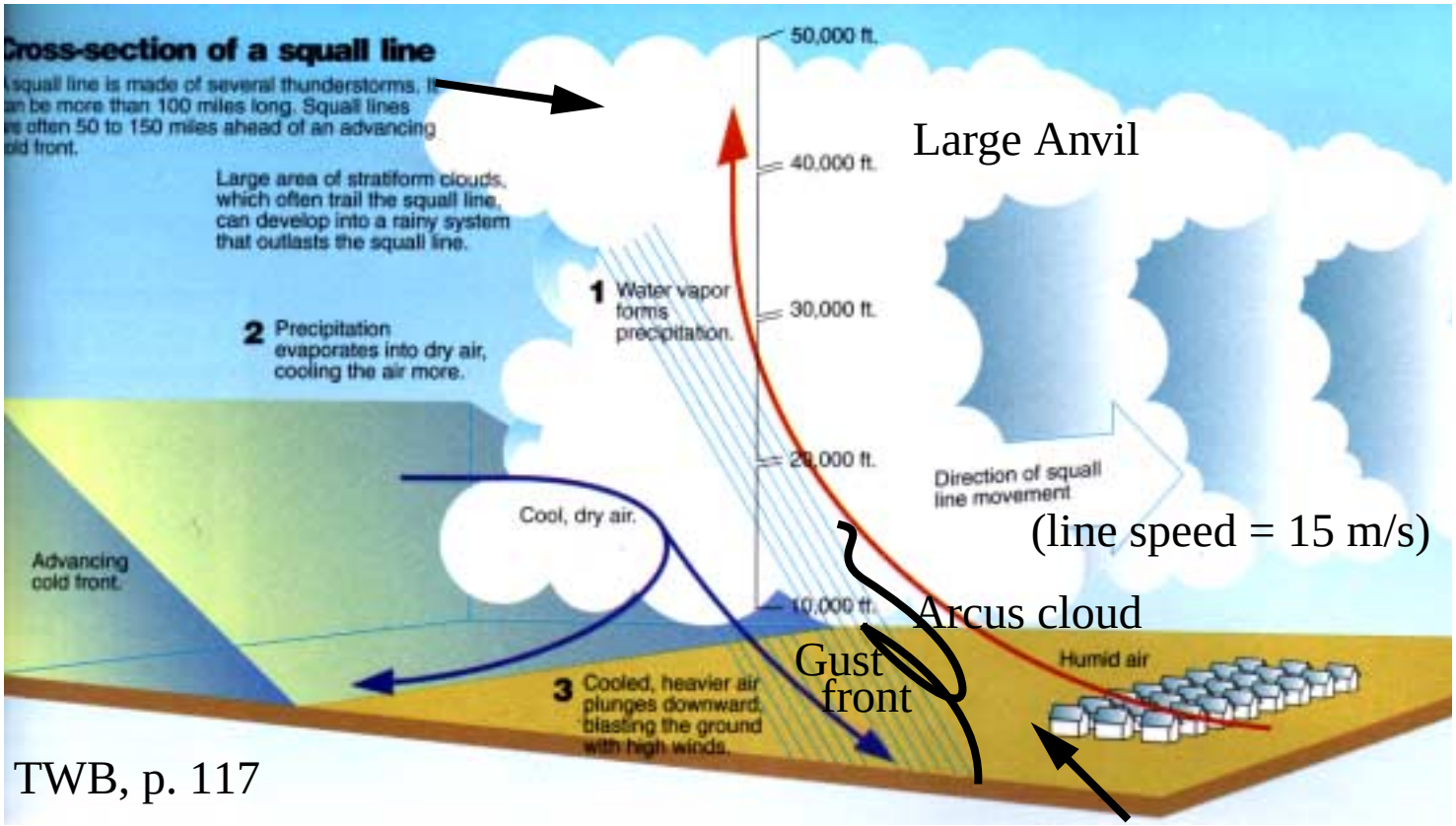
Lecture 28 Severe Thunderstorms and Tornadoes

Squall Lines



TWB, p. 117

- Lines of thunderstorms with merged anvil and surface downdraft
- In Midwest, often form 100-300 km ahead of cold fronts (‘pre-frontal’) feeding on warm, moist air blowing in from S or SE.
- Require a 15-30 m/s difference between surface and upper level winds.
- Damaging winds upward of 50 mph common behind gust front.

Mesoscale Convective Complexes (MCC's)

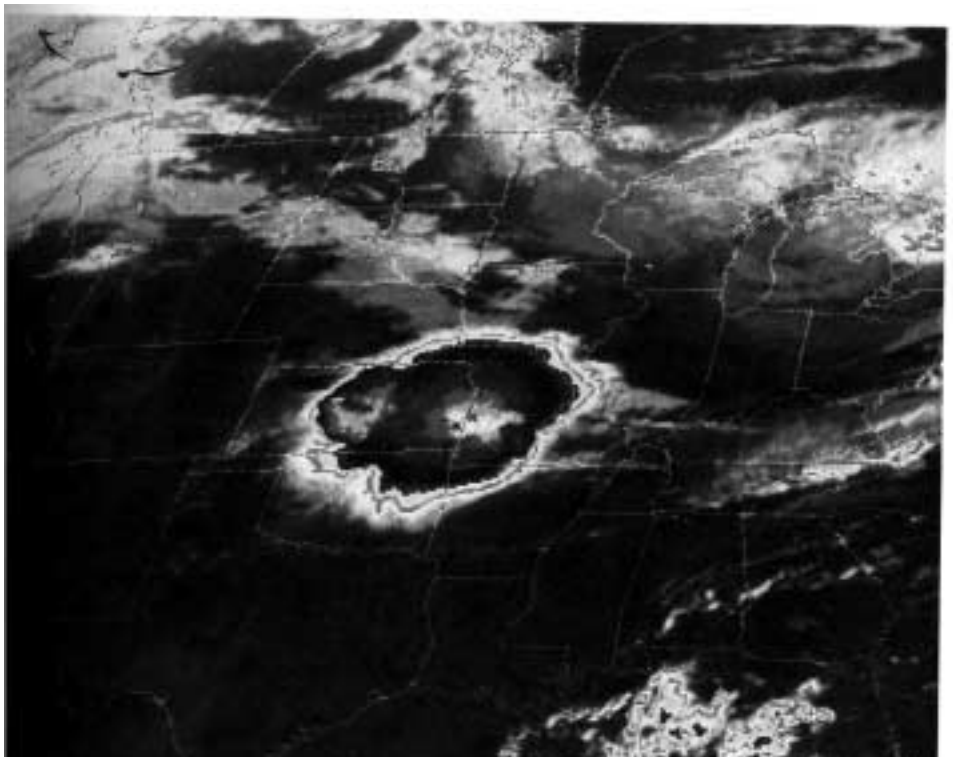


Figure 10.11
An enhanced infrared satellite picture for June 22, 1981, which shows a Mesoscale Convective Complex extending from central Kansas across western Missouri. This organized mass of thunderstorms brought hail, heavy rain, and flooding to this area.

EOM 10.16

- State-size region of thick precipitating anvil cloud produced by many loosely clustered T-storms.
- Form over deep layers of warm humid air blowing from S at low levels well equatorward of jet stream
- Typically form in evening, last all night.
- Flash-flood hazard - 2-4" rainfalls common.
- MCC's cause half of Midwest's summer rainfall

Supercell T-storms

- Form in warm sector close to L when there is deep conditional instability under jet stream winds.
- Whole updraft rotates (usually counterclock-wise, but sometimes clockwise).
- Spawn most torna-does and severe hail.
- Can last for several hours.

(Emanuel, *Atmospheric Convection*)

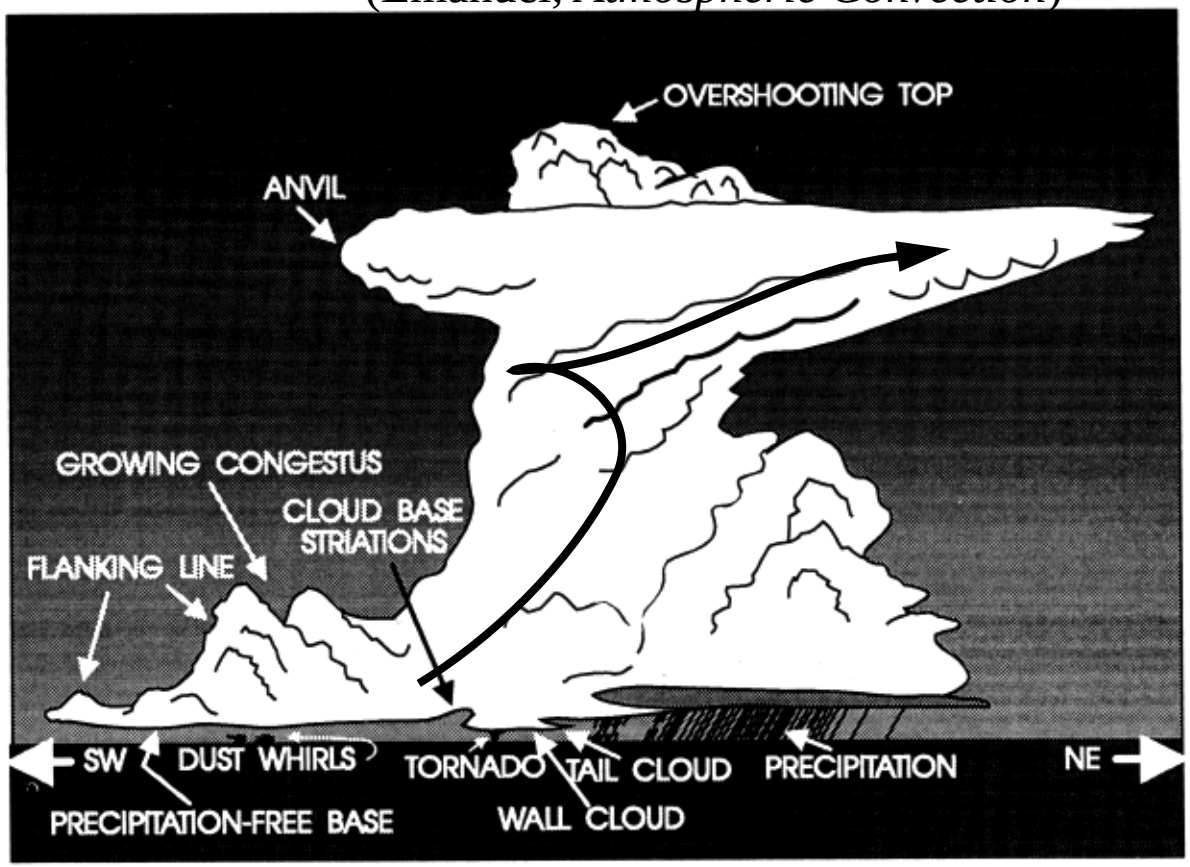
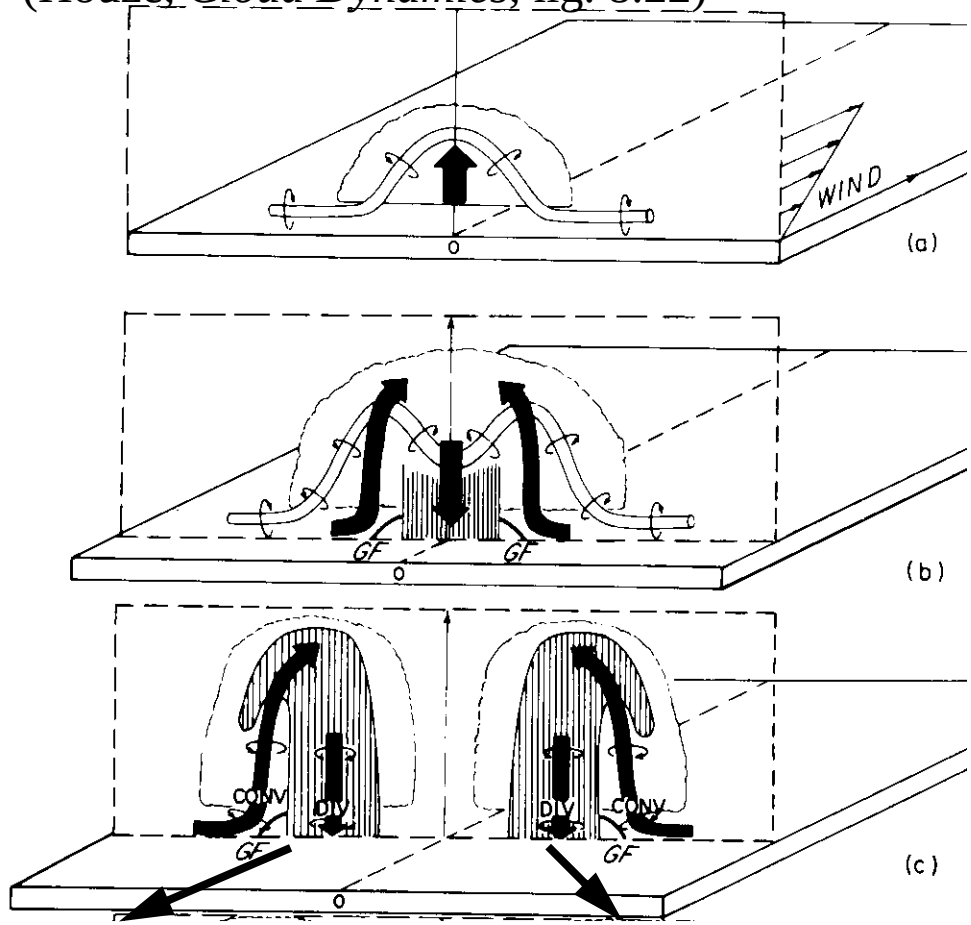


Fig. 9.15 Sketch of tornadic thunderstorm as viewed from the southeast. Vertical scale is exaggerated by about a factor of two. (*Courtesy of Joseph Golden.*)

Supercell formation

- Variation of wind with height ⇒ horizontal spin of air tubes.
- A cumulus updraft twists this spin into counter-rotating vortices.
- The vortices separate, each forming a supercell. Usually the clockwise-spinning vortex dissipates, leaving a single rotating storm.

(Houze, *Cloud Dynamics*, fig. 8.22)



Where Supercells Form

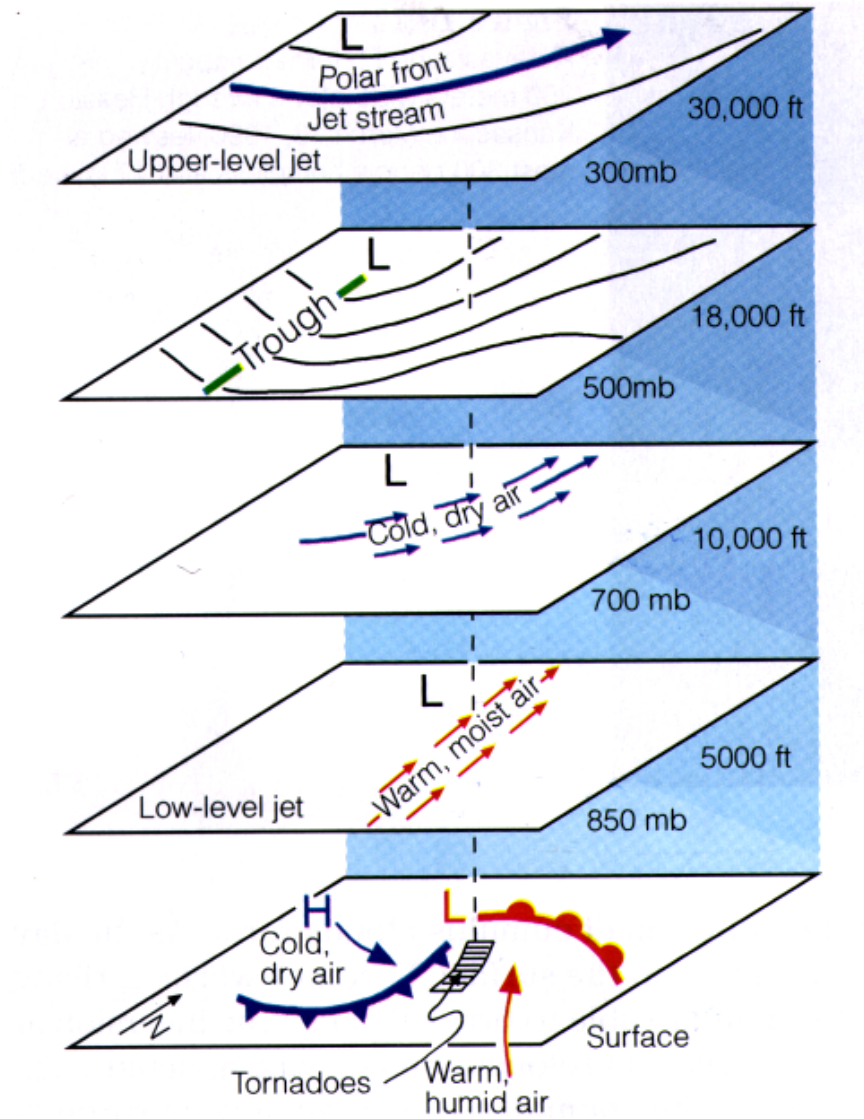
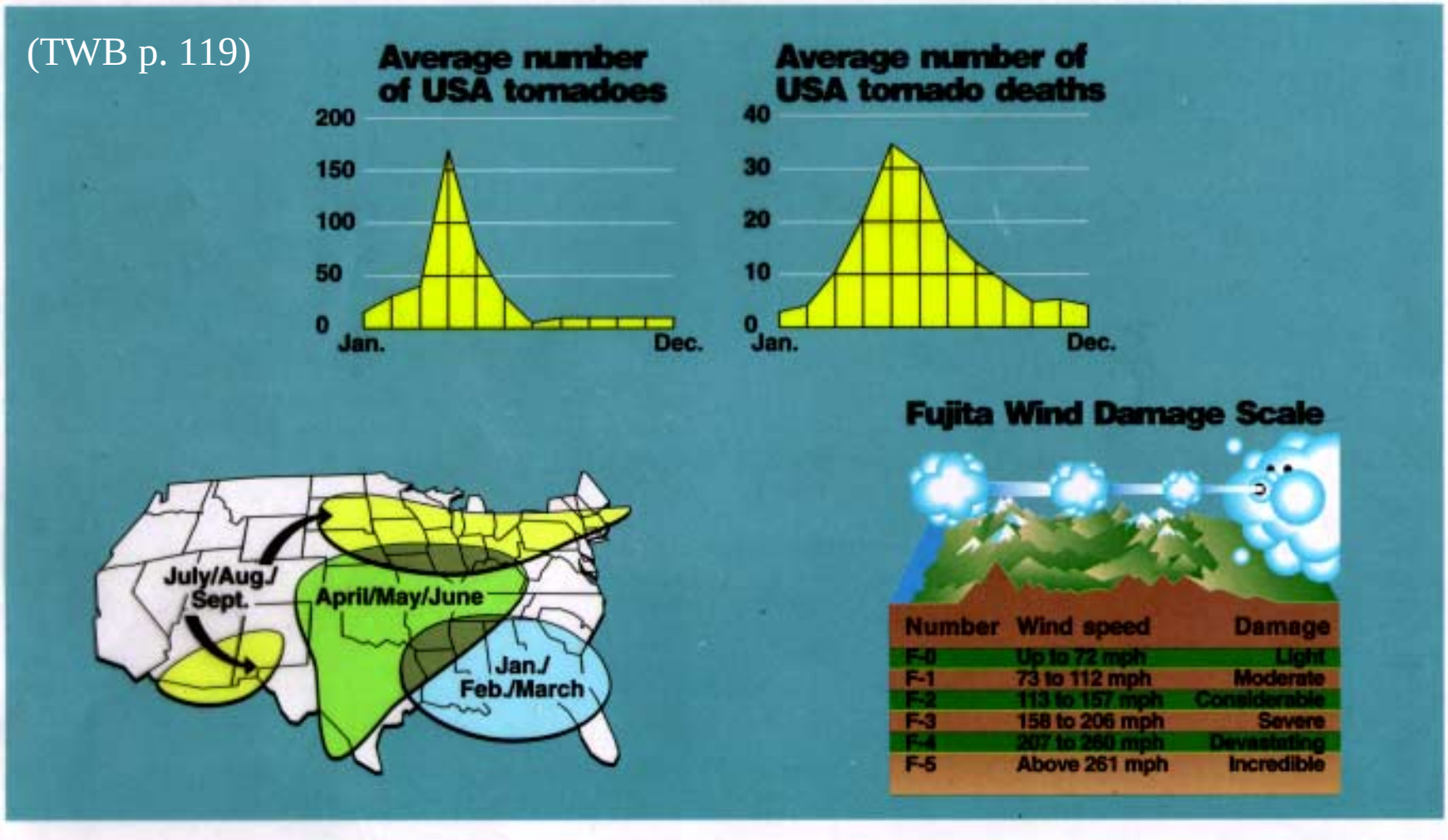


Figure 10.23 EOM 10.31
Conditions leading to the formation of severe thunderstorms that can spawn tornadoes.

Tornado Facts

(TWB p. 119)



Films: Cyclone (segment 1, 20 min), Computer supercell simulation (7 min)