Mesoscale Analysis

Mteor 417 – Iowa State University – Week 5

Bill Gallus

Remember the ingredients needed for thunderstorms?

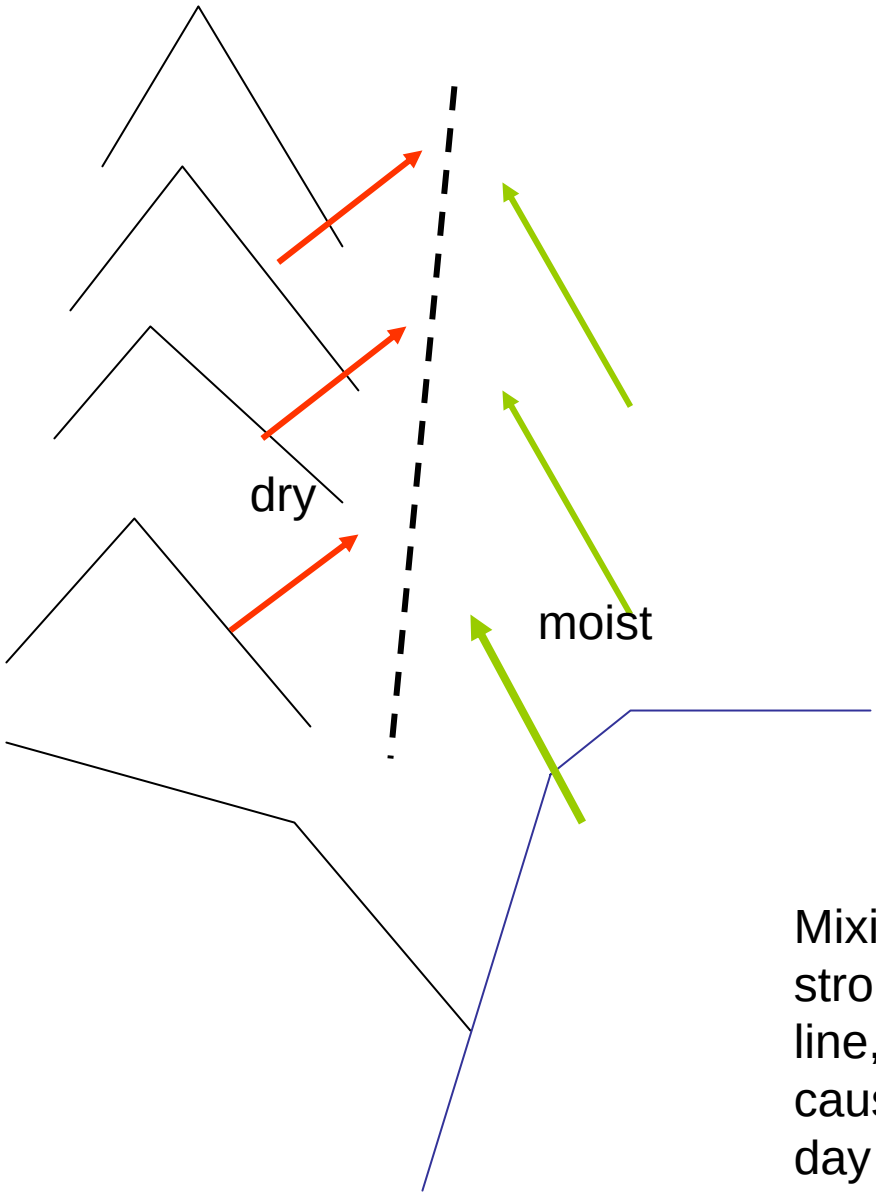
- Instability, moisture, lift
- Most lift comes from mesoscale boundaries

Mesoscale lifting mechanisms

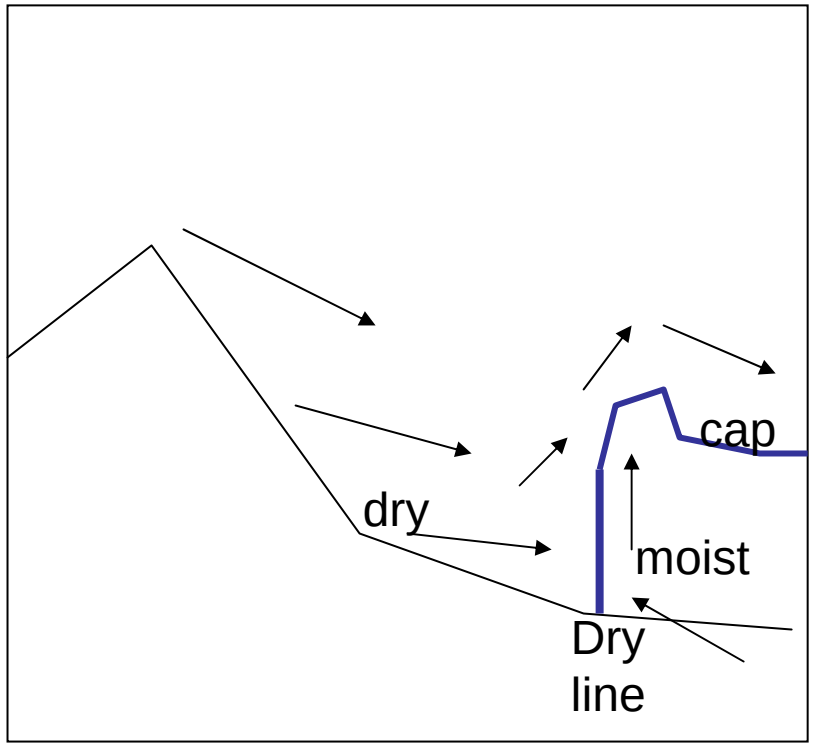
- Fronts (or frontogenesis zones) – lifting is usually rather linear favoring lines of storms
- Dry lines – a significant mesoscale boundary often responsible for convection, many times severe. Why are dry lines so good at causing severe storms and tornadoes?

Dry Lines

- Lift is less linear than cold fronts, so storms may be more isolated and better capable of rotation which helps produce tornadoes
- Formation – due to lee trof allowing SW winds behind it which advects in dry air from deserts and causes it to descend, drying further. This air collides with moist air moving out of the SE from Gulf.



Vertical cross-section



Mixing of hot, dry air downward brings stronger westerlies to ground behind dry line, increasing convergence. Mixing also causes the dry line to move east during the day

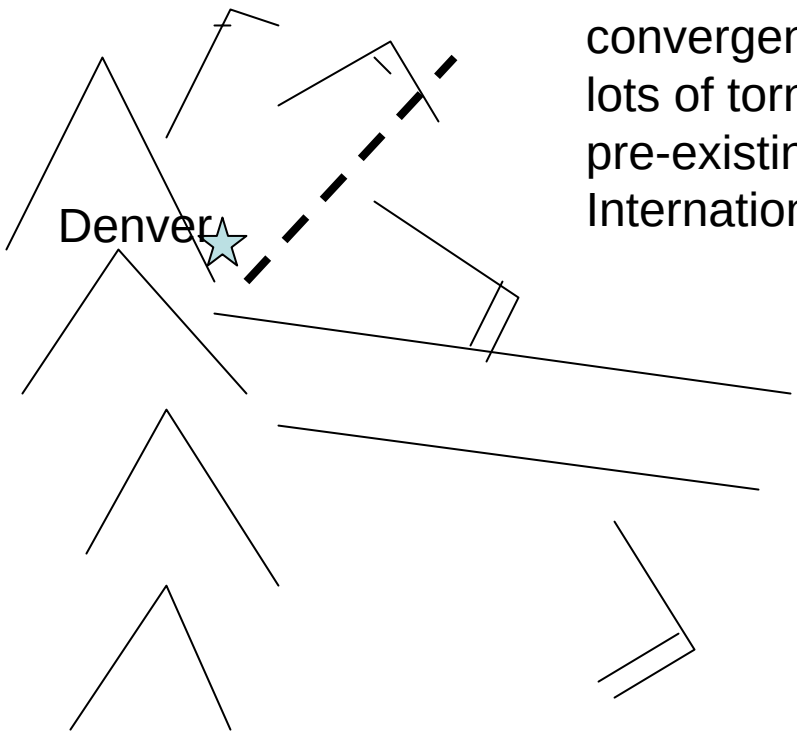
More lifting mechanisms

- Trofs – act like fronts to enhance convergence
- Sea breezes/lake breezes
- Terrain-induced boundaries

Terrain-induced boundaries

- Example is DCVZ (Denver Convergence-Vorticity Zone)

SE flow crosses Palmer Divide and turns into NE flow creating convergence and cyclonic vorticity – lots of tornadoes form here due to pre-existing vorticity (very close to International Airport)



Palmer Divide – higher region of Plains

Outflow Boundaries

- Cause: Entrainment of dry air aloft with evaporative cooling leading to cold downdrafts which spread out at ground
- These boundaries not only cause lift, which can generate new storms, but the air behind the boundaries can have backed winds which alter the wind shear to increase tornado threat

How to determine location?

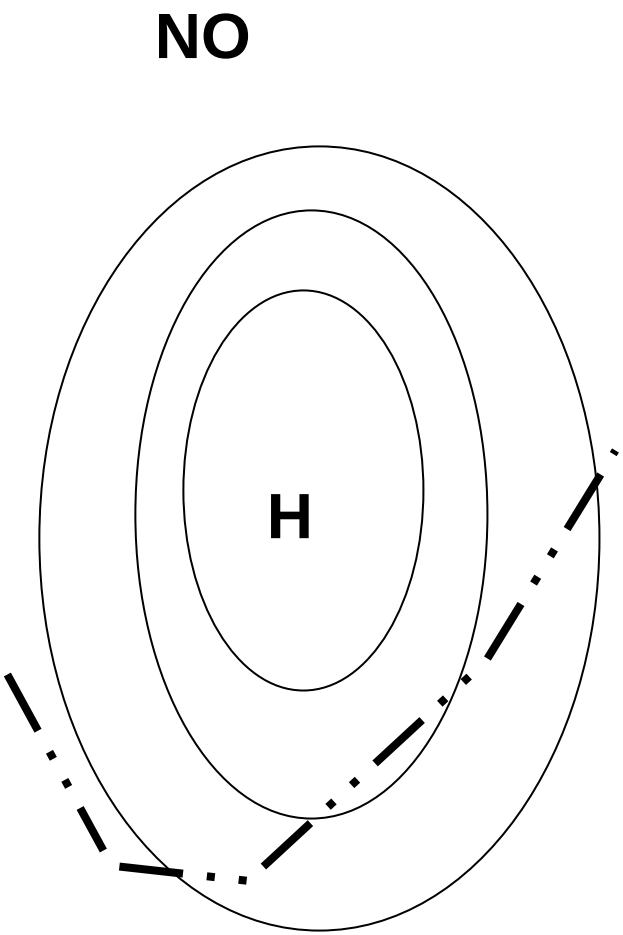
- Wind shift
- Temperature changes
- Dew Point changes
- Pressure changes
- Weather observations/conditions

How to do mesoscale analysis

- Use ALL data
- Easiest with mesonet data

How to do

1. Look at data and lightly mark what you think is happening (general idea of areas with crazy data might imply storms)
2. Try analysis lightly to help “adjust” your first impression
3. Determine boundary locations (using all weather parameters to help)
4. Finalize analysis taking into account the boundaries (adjust contours slightly to fit your analysis)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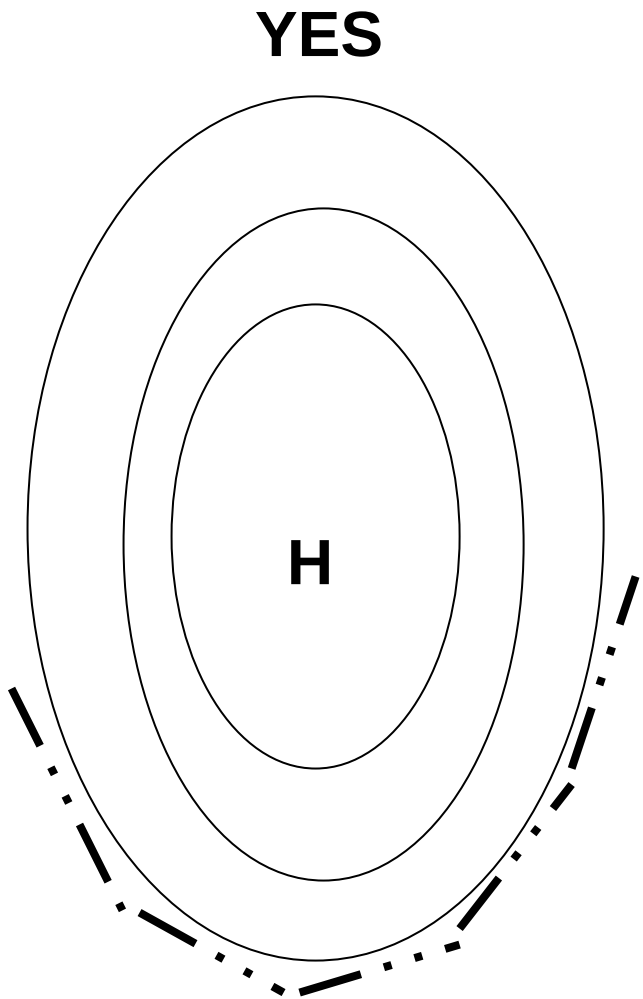
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How to do…

- Be “picky” with the analysis – use it to precisely depict exactly what is happening, adding your own insight as the smart analyst!

Common mistakes

- Missing contour (if using 1 mb interval, you had better not have a 1010 mb line next to a 1012 mb line – there needs to be a 1011 mb in between)
- Lack of proof (don’t have your contours showing snake-shaped valleys of low pressure – always ask “can something in nature create what I am showing?”)
- Make sure contours match your boundaries