

**1. Let us begin with step 1 of the handout “A basic, ingredients-based approach to the convective forecasting process”.**

- **List all locations where convective storms are at least possible based on moisture and instability. Make sure you justify your answer using the maps provided.**
  - Rule of thumb: Do not expect storms unless CAPE rises above 200 J/kg (SBCAPE or MUCAPE). Since CAPE is a measure of moisture and instability, plots of this variable are a good first place to look when trying to determine where convective storms are *at least possible*.
  - Looking at the “250 contours” in the figure showing SBCAPE: Convective storms are at least possible over Northeast Wyoming, Kansas, most of central and southern Texas, the southeastern portion of Mexico shown, as well as locations ahead of the cold front impinging on the Mid-Atlantic region (excluding northern New England).

**2. Continue on to step 2 of the handout “A basic, ingredients-based approach to the convective forecasting process”.**

- **Which among the regions that you identified for question 1 appear to be favorable for the actual initiation of storms based on lifting and CIN? Be sure to use your surface chart and the visible satellite image. You should discuss each unique region separately and be specific about the ingredients. Make sure you justify your answer using the maps provided.**
  - The parcels with CAPE must be able to get to their LFCs. Deep convection is generally impossible when  $CIN < -100$  J/kg, whereas when  $CIN > -25$  J/kg it becomes likely that the cap will break with sustained lifting, such as mesoscale updrafts along boundaries.
  - Region of interest #1: Texas
    - Despite some areas of  $CIN < -25$  J/kg over Texas, I still expect the initiation of storms due to an approaching dry line which will be able to lift parcels up to their LFC. The visible satellite image shows clear skies over much of Texas. Abundant surface heating should aid in reducing CIN (especially the higher magnitudes as seen over central Texas) such that convective initiation will still occur.
  - Region of interest #2: Kansas
    - Convective initiation appears favorable in this region due to two lifting mechanisms that are able to overcome scattered areas of slightly large SBCIN ( $-25 \rightarrow -100$  J/kg): a frontal boundary draped over the state as well as lifting of parcels due to daytime surface heating where the skies become mostly clear throughout the day.
    - Surface and 850 mb charts indicate a dry boundary layer, which suggests that any convection over the state will be high-based.
  - Region of interest #3: Louisiana into the southern Appalachians  $\rightarrow$  Appalachians into Pennsylvania & New York
    - High CAPE values ( $> 1000$  J/kg in some areas) collocated with low CIN
    - The frontal boundary stretching south from the Great Lakes as well as topographic lifting associated with the Appalachian Mountains will be the lifting mechanisms for this region

**3. Now we will consider step 3 of the handout “A basic, ingredients-based approach to the convective forecasting process”. Assess the vertical wind shear of the environment. You are provided with the 0-6 km shear and 0-3 km SRH charts; for the 0-3 km shear, you will have to do some eyeballing using your surface and 700 mb charts.**

- **Which among the regions that you identified for question 2 appear to be favorable for supercells? If not supercells, then which appear to be favorable for multicells?**
  - Greater vertical wind shear favors more organized storms, including squall lines and supercells. Look for 0-6 km shear vector magnitudes  $> 20$  m/s (40 kt) before forecasting supercells. Look for 0-3 km shear vector magnitudes  $> 10$  m/s (20 kt) before forecasting severe squall lines. You should be able to compute an actual sfc-700 mb vector wind difference by using a ruler and a hodograph.
  - Region of interest #1: Texas
    - Supercell development is favorable over the northern half of Texas as well as the southern tip of the state due to 0-6 km shear  $> 40$  kt. However, at least at 1900 UTC, SBCAPE is not necessarily substantial over the Texas Panhandle and other locations just south of the Oklahoma border.
    - Eyeballing the surface and 700 mb charts, I notice that the 0-3 km shear over central Texas is  $< 20$  kt, so severe squall line development will not be favored. Given a few locations of modest 0-3 km shear ( $\sim 10$  kt), I will not rule out the chance of isolated strong multicells and pulse “severe” storms.
  - Region of interest #2: Kansas
    - Supercells are possible in this region due to 0-6 km shear above 40 kt. Though inadequate surface moisture indicates that any supercells formed would be LP and high-based.
  - Region of interest #3: Appalachians into Pennsylvania & New York
    - Moderate, but shallow (0-3 km) vertical wind shear will favor multicells in this region, with the advancing cold front acting as the strong linear triggering mechanism.

**4. Combine what you’ve learned from above to provide a severe weather outlook. *You should discuss each unique region separately and be specific about the ingredients.* Make sure you justify your answer using the maps provided.**

- **a) Will the storms in the region be organized? How?**
- **b) Will CAPE values in the region be large?**
- **c) Based on the DCAPE and LCL heights, do you expect severe winds in the region from strong downdrafts? Why?**
- **d) Based on the hail chart (CAPE in the mixed-phase region, freezing level height, and 0-6 km shear), do you expect severe hail in the region? Why?**
  - Ample CAPE ( $> 100$  J/kg) in the mixed-phase region of the cell allows updrafts to suspend hailstones in the air while supercooled water droplets continuously rime onto them, thus adding more layers of ice and increasing their diameter.
  - High 0-6 km shear suggests that the storm’s updraft will be tilted (such as with supercells), allowing it to be separated from the downdraft, so updrafts can be long-lived and can grow hail over longer periods of time.
  - Analysis of the freezing level can indicate the length of time hailstones would have to melt as they fall to the surface. Additionally, the freezing level can also indicate the vertical depth in which hailstone formation and growth is possible. The lower the freezing level, the greater the potential for hail formation and preservation.

- **e) Based on what you know, do you expect tornadoes in the region?**

- First look for parameters that favor supercells:
  - CAPE > 1000 J/kg coexisting with 0-6 km shear vector magnitudes > 40 kt
- Next look for environments in which the wind shear vector turns with clockwise height
  - Larger values of 0-3-km SRH (> 250 m<sup>2</sup>/s<sup>2</sup>) suggest an increased threat of tornadoes with supercells.
- Finally, look for environments in which the boundary layer relative humidity is high (small dewpoint depressions, low LCLs, etc.)
- Since there is no region where there exists a juxtaposition of all necessary criteria, I would not expect tornadoes over any of the regions of interest, unless CAPE increases due to insolation in Texas.

- **Severe weather outlook**

- Region of interest #1: Texas
  - There will be a risk of supercells over northern Texas, while the rest of the state should expect multicellular convection
  - CAPE values will indeed be large over central and southern Texas today given the pre-existing high SBCAPE, patches of clear skies, and supply of low-level moisture from the Gulf of Mexico.
  - I expect severe surface winds over southern Texas due to the high potential for evaporative chilling driving strong downdrafts. In this region, DCAPE is > 800 J/kg and < 1500 m
  - I expect severe hail in central Texas due the juxtaposition of ample CAPE in the typical mixed-phase region of the atmosphere, moderate/high shear, and freezing levels around 3 km.
- Region of interest #2: Kansas
  - Possibility of high-based, LP supercells
  - CAPE values in Kansas will not be that impressive today. At 1900 UTC, SBCAPE over the state was only around 250 J/kg. Overall, CAPE values should increase somewhat since there are still a few more hours of sufficient daytime heating so that boundary layer lapse rates are able to increase for areas experiencing mostly sunny skies.
- Region of interest #3: Appalachians into Pennsylvania & New York
  - Multicellular convection expected associated with the eastward-moving cold front
  - Prefrontal CAPE values will be high enough to sustain severe weather today. Generally, there is low SBCIN that will easily be compensated for by lifting along the cold front.
  - I expect severe surface winds over South Carolina, throughout the Mid-Atlantic Region, and into western New York. In these regions, there is widespread small CIN as well as great potential for evaporative chilling. DCAPE values are > 500 J/kg over most of this region, with a “bull’s eye” of > 1100 J/kg over North-central Virginia.
  - I expect severe hail in isolated locations along the cold front where mixed-phase region CAPE is greater than 100 J/kg. Cold frontal passage will feature increased shear and lowering freezing level heights.





