IC5.2: Optional Job Sheet Answer Key

Diagnosing Mesoscale Internal Forcing—Frontogenesis

Question 1. Where would you expect to find a secondary ageostrophic circulation?

You expect to find an ageostrophic circulation associated with strong frontogenesis, and the rising motion is on the warm side of the frontogenesis maximum. In this case, we expect to fine the ascending branch of the circulation sloping upward over the frontal zone and just south of the frontogenesis maximum. The region around southwest Iowa, southeast Nebraska, and northwest Missouri appear to be the most favorable for the the ascending branch of the ageostrophic circulation.

Question 2. Is there any sign of such a circulation, and if so, where is it located?

In the same location as the answer to question 1. We see strong rising motion on the warm side of the frontogenesis maximum, and the horizontal branch of the circulation shows northerly ageostrophic flow in the lowest levels and southerly ageostrophic flow above the front, consistent with the conceptual model of ageostrophic circulations resulting from frontogenesis.

Question 3. What do you think is causing the vertical motion over southern Iowa?

Looks like a clear example of frontogenetical forcing.

Question 4. Where are the upper- and lower-level circulations coupled? (list a vertical layer and a general geographic location)

Because the cross section we took was east of the maximum in Q-vector convergence, our cross section didn't show a good deal of coupling between upper and lower level circulations. However, if your cross section was cut across eastern Nebraska along the max in Q vector convergence, you would indeed see coupling throughout the depth of the atmosphere across extreme eastern Nebraska.

Question 5. Does this appear to be frontogenetic or frontolytic? (circle one)

Clearly frontogenetic

Question 6. Where is the convergence maximized?

Western Iowa

Question 7. Do you expect any enhanced frontogenesis from diabatic effects?

This question was open ended by design and very subjective. Based on surface obs, lack of significant convection, and saturated conditions near the surface in all around the frontal zone, it does not appear that diabatic effects will be a significant player for frontogenesis.

Question 8. Where and at what forecasted time might the PV anomaly strengthen and/or couple with the frontogenesis?

There is very little significant coupling of the PV anomaly and frontogenesis at the heights indicated in the instructions. However, there are indications of slight coupling at the 6 hr forecast along the west end of the PV anomaly. At 12 hrs (00 UTC on 16th) North-central Kansas has some coupling, and at 18 hrs Missouri has a pretty good coupling signature.

Question 9. At what height are frontogenesis and Div-Q coupled to produce maximum forcing? Where geographically is this coupling located?

All frontogeneis heights show a coupling over eastern Nebraska and western Iowa.