Synoptic Meteorology II

**Lab 10: Diabatically Driven IPV Changes**

Wednesday, May 10th, 2023

(100 pts)

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Due: May 17th, 2023, at 2:30 pm

**Learning Objective**:

* Explain how diabatic processes can alter IPV anomalies and apply that understanding to diagnose the tropical transition of an extratropical cyclone.

**Things to know:**

Feel free to use the Internet and collaborate with your colleagues when answering these questions. For the entire lab, the requested plots must be obtained using the Jupyter Notebook on our JupyterHub before you can complete the questions.

**Part I: Extratropical-to-Tropical Cyclone Transition**

1. Create the following figures using the JupyterHub: (15 pts)
   1. 330 K Potential Vorticity (PVU) and Wind (kt) for June 17th, 2012 at 1200 UTC
   2. 330 K Potential Vorticity (PVU) and Wind (kt) for June 18th, 2012 at 0000 UTC
2. Describe the changes in the 330-K pressure, wind, and IPV fields with the disturbance between the two maps you created. (10 pts)
3. Using the attached satellite image, assess the proximity of deep, moist convection to the positive IPV anomaly of concern on June 18th, 2012 at 0000 UTC. What could the deep, moist convection do, assuming its diabatic heating is maximized in the midtroposphere, to weaken the upper-level positive IPV anomaly? Hint: Explain what will happen to the configuration of the isentropes in the vertical in the upper levels over time due to the deep, moist convection. (25 pts)
4. How would the deep, moist convection change the lower-tropospheric IPV in subsequent hours? Again, explain what will happen to the configuration of the isentropes in the vertical at low levels due to the deep, moist convection. (25 pts)
5. What will happen to the surface wind field in response to the changes in IPV and isentrope configuration described in #4? Explain your answer. (25 pts)

**Part II: Physical Understanding of Extratropical-to-Tropical Cyclone Transition (Graduate Students Only; 10 pts)**

1. Reduced vertical wind shear and weakened baroclinicity are necessary (but not sufficient) conditions for tropical cyclone development to occur. Given this and your answers to the preceding questions, explain how the development of deep, moist convection atop or just ahead of the extratropical cyclone, like we saw in the case, is considered a hallmark of the "tropical transition" process. Hint: how might weakening upper-level IPV reduce vertical wind shear? And how might reducing the vertical wind shear reduce the baroclinicity near the surface?

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