Synoptic Meteorology II

**Lab 8: Isentropic Potential Vorticity**

Wednesday, April 19th, 2023

(100 pts)

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Due: April 26th, 2023, at 2:30 pm

**Learning Objective**:

* Interpret dynamic tropopause and isentropic potential vorticity (IPV) maps.

**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: The Dynamic Tropopause**

1. Using the JupyterHub, create the following charts for March 10th, 2023 at 1200 UTC (25 pts):
   1. 300 hPa geopotential height (m), temperatures (°C), and wind barbs (kt)
   2. Dynamic tropopause potential temperature (K) and wind barbs (kt)
   3. 300 K potential vorticity (PVU) and wind barbs (kt)
   4. Skew-*T*/ln-*p* diagrams for:
      1. KGGW (Glasgow, MT)
      2. KSLE (Salem, WA)
      3. KDVN (Davenport, IA)
2. Using the skew-*T*, ln-*p* diagrams, infer the pressure and potential temperature of the tropopause at Glasgow, MT (KGGW), Salem, WA (KSLE), and Davenport, IA (KDVN). (10 pts)
3. Using your Skew-*T*, ln-*p* diagrams and 300 hPa analysis, is the tropopause lower or higher in the middle of a trough/ridge? Explain why this should be expected. (12.5 pts)
4. Using the 300 hPa temperature map, determine the air temperature at KGGW, KSLE, and KDVN. Why might the temperaturein the trough appear warm compared to its surroundings on the isobaric surface? Does this hold true for your potential-temperature analysis on the dynamic tropopause? (12.5 pts)

**Part II: Isentropic Potential Vorticity**

1. Explain why IPV is typically much larger in the stratosphere than the troposphere. (10 pts)
2. Using your 300-K potential vorticity map, how does the 2 PVU contour (defining the dynamic tropopause) compare with the 300 K isentrope on your dynamic-tropopause potential temperature map? (5 pts)
3. How do the IPV contours on your 300-K potential vorticity map compare to the isohypses on your 300 hPa map? (5 pts)

**Part III: Identifying the Dynamic Tropopause in Real-Time (20 pts)**

1. Using a GFS forecast of the Dynamic Tropopause Pressure @ 2PVU from <https://weather.cod.edu/forecast/>, identify the region over North America with the lowest tropopause height over the subsequent five days. If two areas/times have the same/similar pressure, choose the one closest to the Equator. What is the pressure of the dynamic tropopause (2 PVU) shown by the model at this location/time? Click for one second at this location to generate a model-derived skew-*T*, ln-*p* diagram and use this diagram to identify the tropopause. Does the 2 PVU pressure suggested by the model match that which you infer from the skew-*T*/ln-*p* diagram at that location.? **Turn in all of your maps with the lab.**

**Part IV: Isentropic Potential Vorticity, Continued (Graduate Students Only; 10 pts)**

1. Using the charts that you created in Part I, describe the relationship between wind speed and (a) the magnitude of the horizontal potential-temperature gradient on the dynamic tropopause and (b) 300-K IPV. Focus on the region extending from eastern ND and eastern IA to western Nebraska (10 pts).