Review of Norwegian Cyclone Model and ISU weather data analysis software

Meteorology 411 – Iowa State University – Week 1

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Some initial questions…

- How do we get low pressure systems?

  Are lows stamped out in a factory in the Pacific and then they float along in the flow around and around the world? After all, don’t the Canadians create cold fronts and then send them our way? *

Some initial questions…

- Is all weather near lows bad, and all weather near highs good?

- ANSWER: NO. “Bad weather” is due to lift and moisture supply which combined create clouds and precipitation. This usually happens in <u>some</u> regions close to lows, but some highs can also result in bad weather, especially if mountains are there to lift the air (Front Range of Rockies)

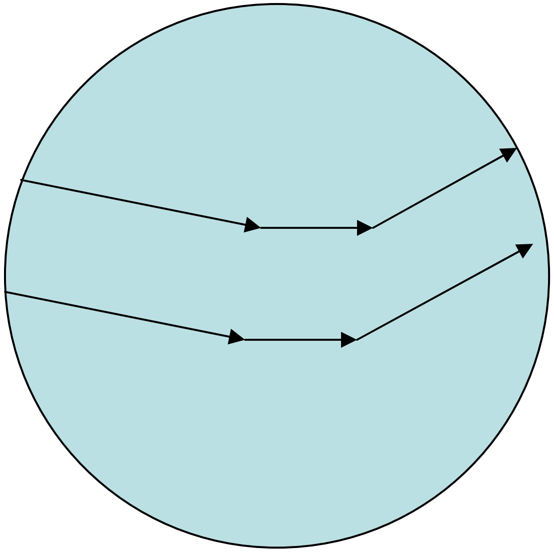
Some initial questions…

- Why do systems tilt rearward with height?

Answers to questions 1 and 3 come from the following discussion and understanding about the atmosphere.

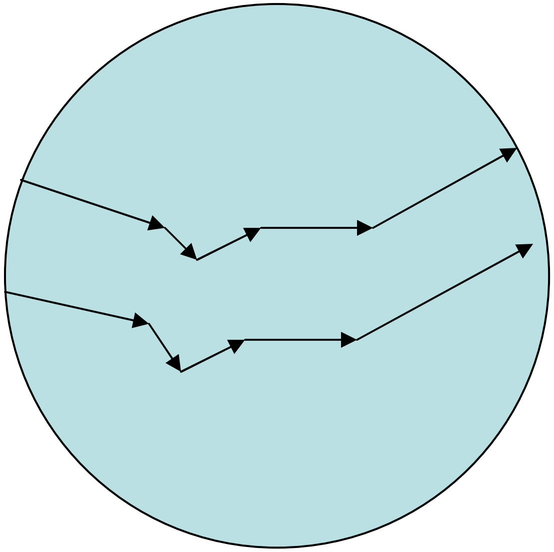
Would we have any weather on our planet if there were no mountains and oceans, and the flow aloft was always zonal?

- NO

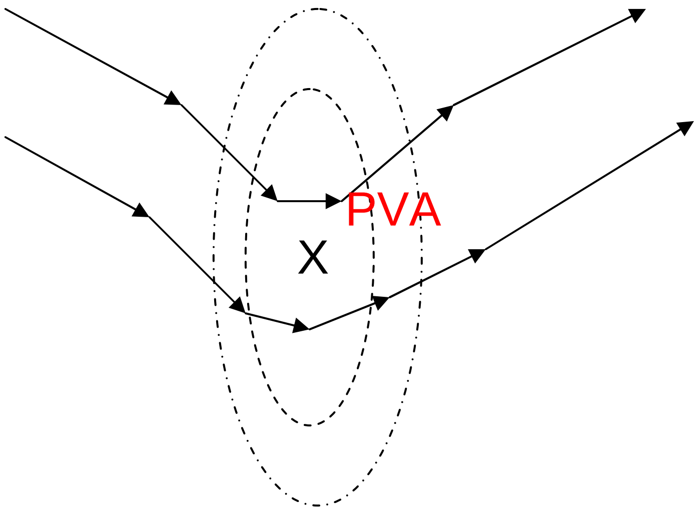


What happens when we get wiggles (shortwave troughs) in our upper flow?

With wiggles, vorticity is maximized in the wiggle/trof due to more curvature being present which implies more spin there



- So we see…



Air travels through the pattern (moves faster than the trofs/ridges) and must slow down its spin (vorticity) as it exits the wiggle/trof. To do this, it must diverge like an ice skater spreads out their hands to slow down their spin.

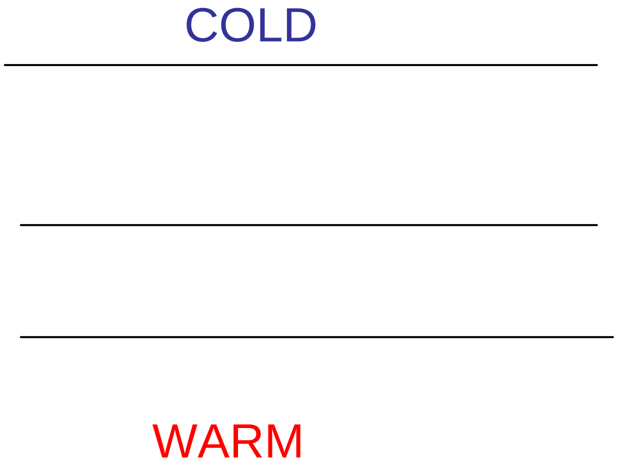
On a weather map, this shows up as positive vorticity advection (PVA)

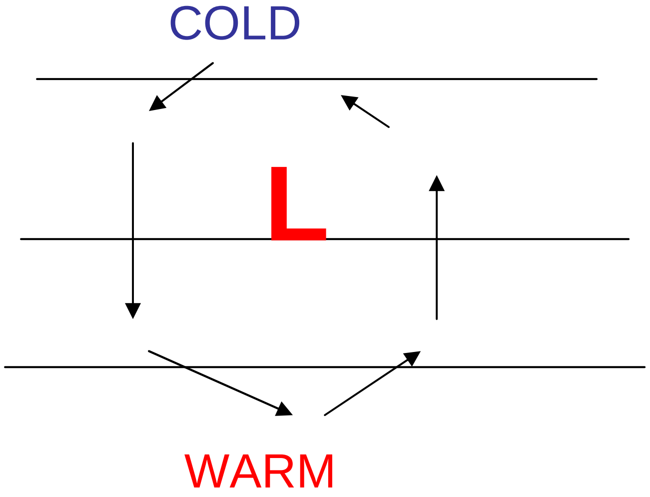
How we get low pressure systems

- Divergence aloft leads to rising motion since air below must come in to take its place (and we also end up with low-level convergence)
- But, friction near the ground slows down the converging air, so we don’t totally replace the air diverging aloft, and the pressure ends up falling since we removed air.
- THUS, we have shown we get surface pressure falls and lows in front of the trough aloft, which is WHY systems tilt rearward with height (same arguments can be applied to ridges)

Add temperature effects…

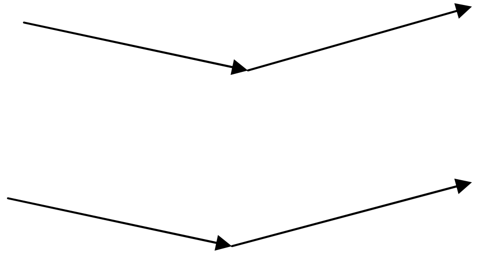
- If we have a temperature gradient, once we form a low, we'll get temperature advections as the counterclockwise circulation brings warm air north ahead of the low, and cold air south behind it.



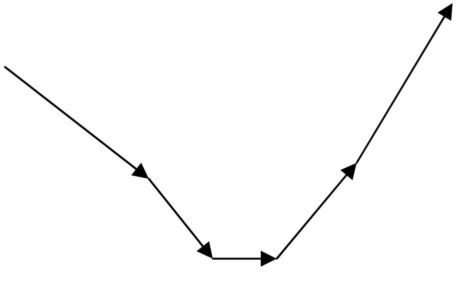


Positive feedback kicks in…

But… warm advection raises upper-level heights and cold advection lowers them, so we create a runaway feedback. Once we form the surface low, we end up changing the upper-level pattern from



TO

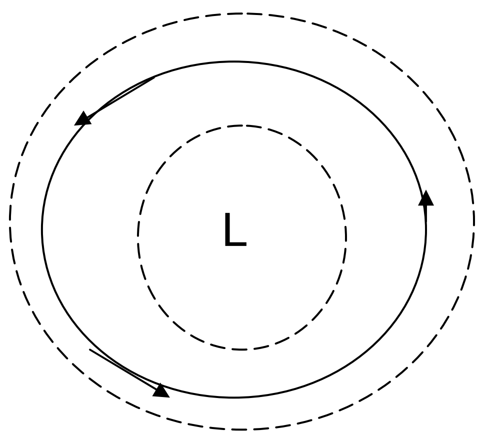


Have we destroyed the earth?

- As the trough deepens, the amount of vorticity in it increases, and so does the PVA, so the surface low gets even stronger (lower pressure). This makes the temperature advections even stronger, and the height changes aloft bigger, so the PVA gets even bigger, and so on and so on…

The brakes…

- Eventually, heights will fall so much above the surface low that a cutoff or closed low will form aloft. When this happens, the PVA pretty much stops since the flow is moving in a circle, and the height lines will be parallel to the vorticity lines.



End of cyclone…

- With no more PVA, the surface low cannot deepen any more, and instead, friction will now slowly allow it to weaken.

PART 2 of Lecture 1: Software for weather analysis at ISU.

- Unidata (based in Boulder) provides much software that works on linux systems
- ntl – allows access to most of this software which includes:

  nwx – text weather viewer

  nsharp – sounding analysis/modification

  nmap2 – cool display/overlaying

  garp – GUI for gempak
- Gempak – lots of programs (launched by typing program name like sfmap, gdcntr, gdplot….)

PART 2 of Lecture 1: Software for weather analysis at ISU.

- Unidata also has created IDV which runs on both windows and linux (so anyone in the country can access it)
- Go to http://www.unidata.ucar.edu/software/idv/
- On our linux systems, type runIDV

PART 2 of Lecture 1: Software for weather analysis at ISU.

- Two software systems are independent of Unidata and must use Windows
  - Bufkit (great for displaying model data related to rain vs snow, and amounts)
  - Gibson Ridge products (for radar data)