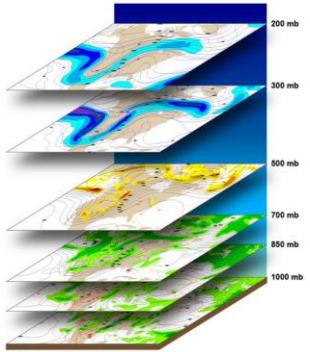
Chart Analysis

Marine Meteorological Course for Royal Oman Navy



Content creator: Souha alsibli
Lecturer: Mahmood Al busaidi, Souha Al shibli

Content

- Introduction to Upper Air Charts
- Longwaves and Shortwaves
- Basic Wave Patterns
- Common Features of Constant Pressure Charts
- Constant Pressure Charts
- The surface chart

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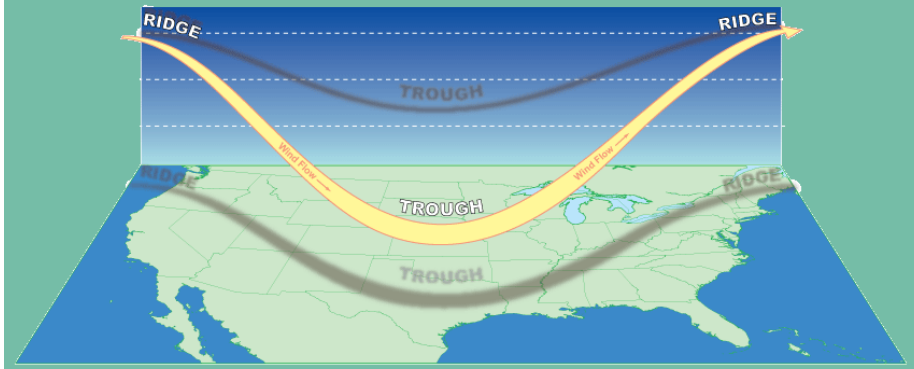
Chart Analysis

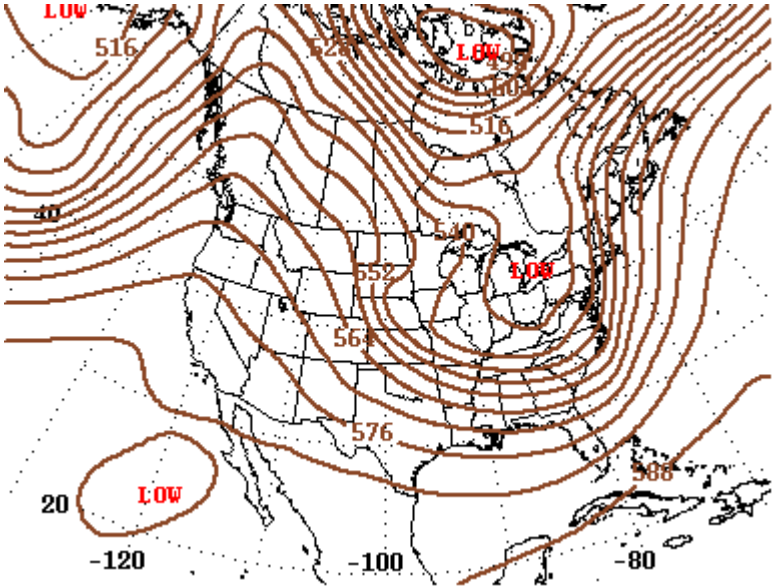
ⓘ Start presenting to display the poll results on this slide.

Introduction to Upper Air Charts



Introduction to Upper Air Charts

In most aspects of weather, observed values of pressure and temperature are not as important as the ***change in*** pressure or the ***change in*** temperature. In meteorology, we refer to the "change in" as a ***gradient***.

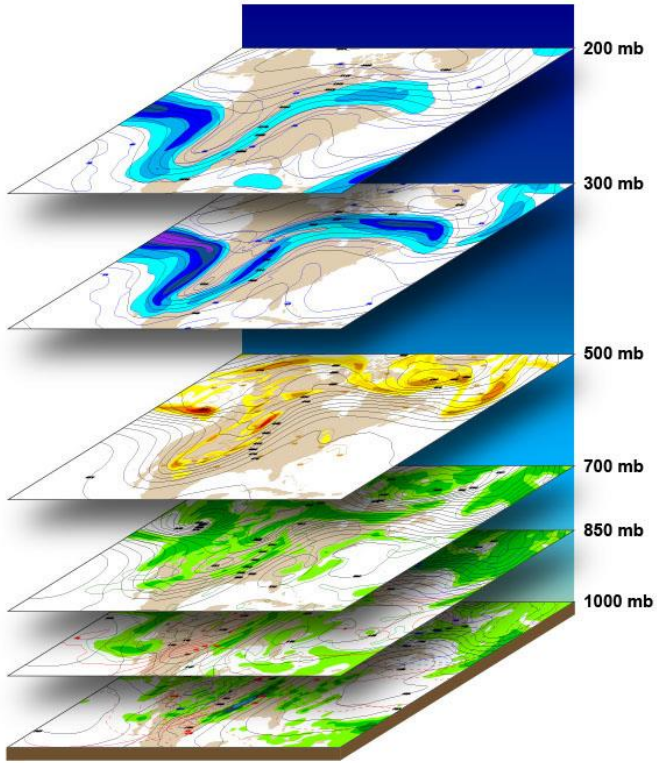


Constant Pressure vs. Constant Elevation

"Iso" means equal, and "bar" is the unit by which we measure pressure.

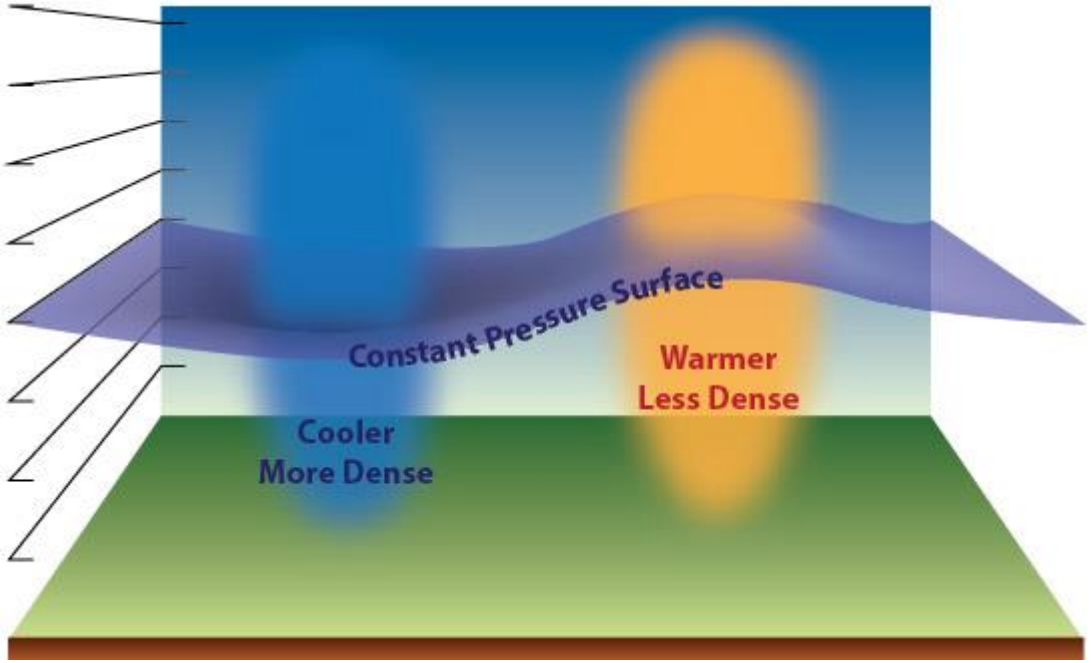
Isobar: a line representing the location where the pressure is equal (the same) *along* that line.

Isoheights: lines on constant pressure chart represent the altitude at which that particular pressure occurred.



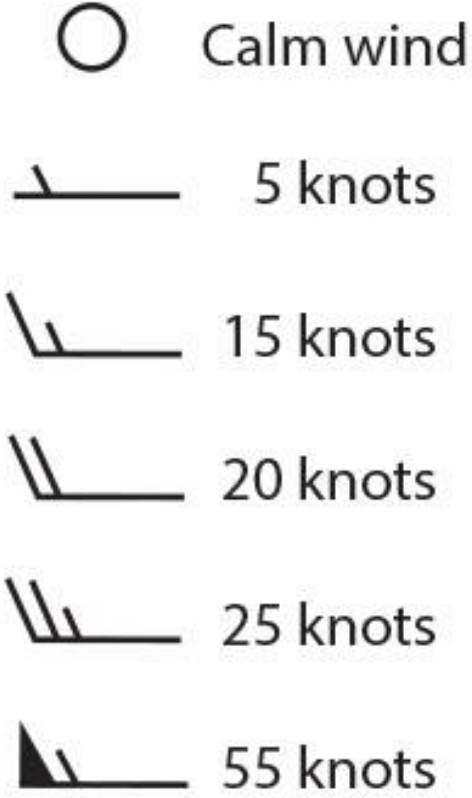
Height Contours

- The areas of lower heights (colder, more dense air) are called **troughs**. The regions of higher heights (warmer, less dense air) are called **ridges**.

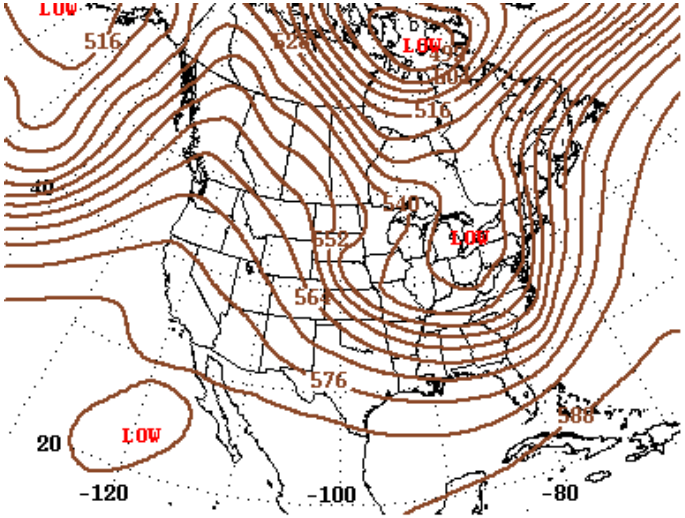


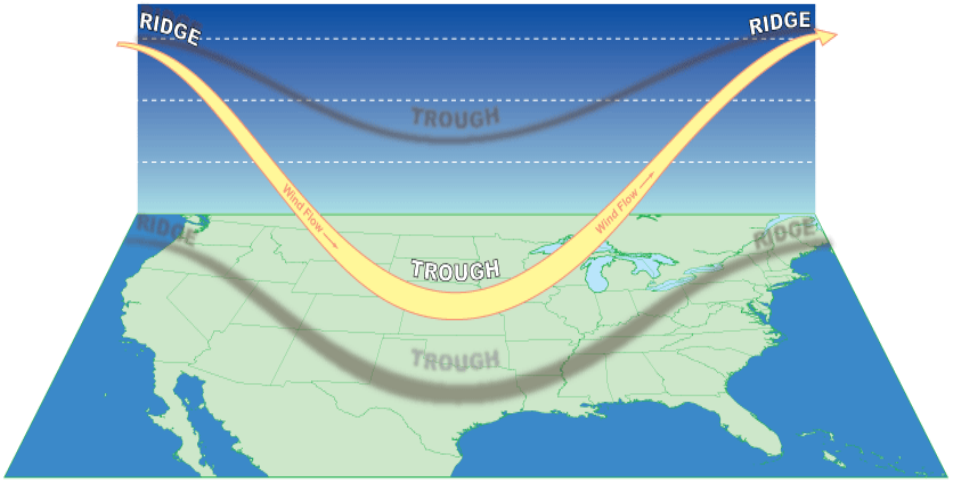
Wind Direction and Speed

- The motion of the air in the upper atmosphere is usually west to the east in both Northern and Southern Hemispheres and will parallel or closely parallel the contours.
- When the height contours (lines) are close to each other, it means there is a more rapid change in altitude of the constant pressure level, and indication of a large temperature gradient.
- As the temperature gradient increases (more rapid change) so does the pressure gradient. Wind is created when there is a pressure gradient, and the stronger the gradient the stronger the wind.



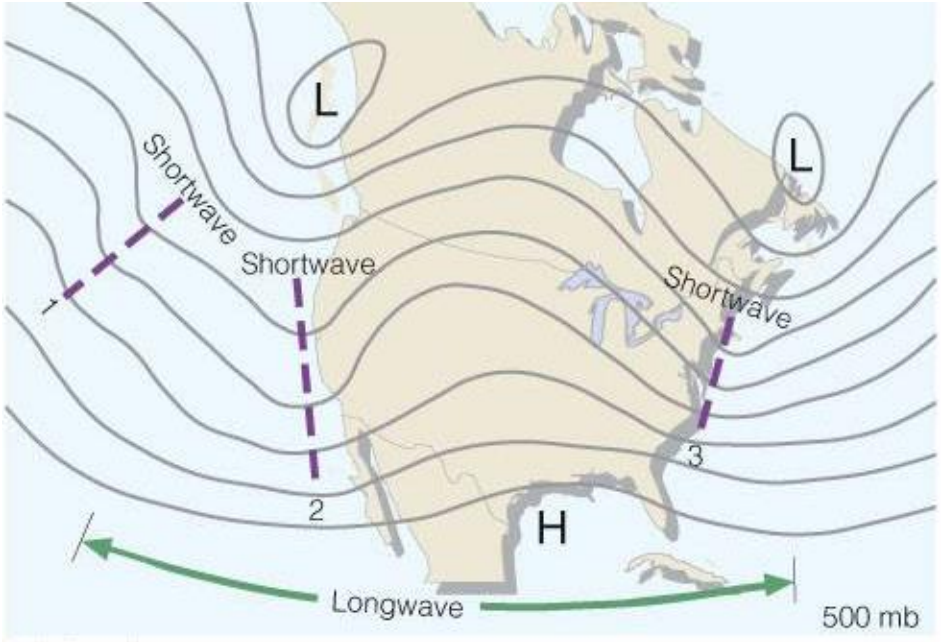
Ridge and Trough





By looking at these contours we observe patterns of higher heights (called ridges) and lower heights (called troughs). These ridges and troughs drive the weather we experience at the surface.

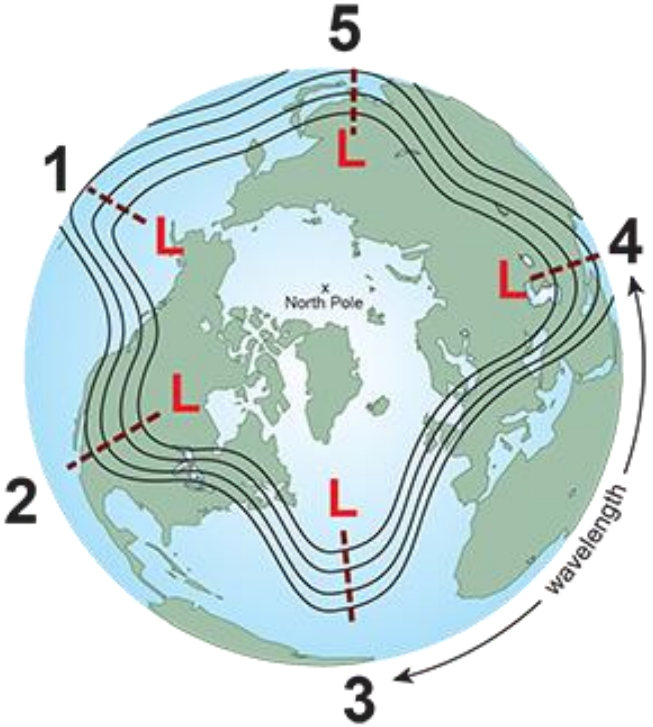
Wind flowing from a ridge toward a trough is decreasing in height above the surface. Conversely, wind flowing from a trough into a ridge is increasing in height.



Longwaves and Shortwaves

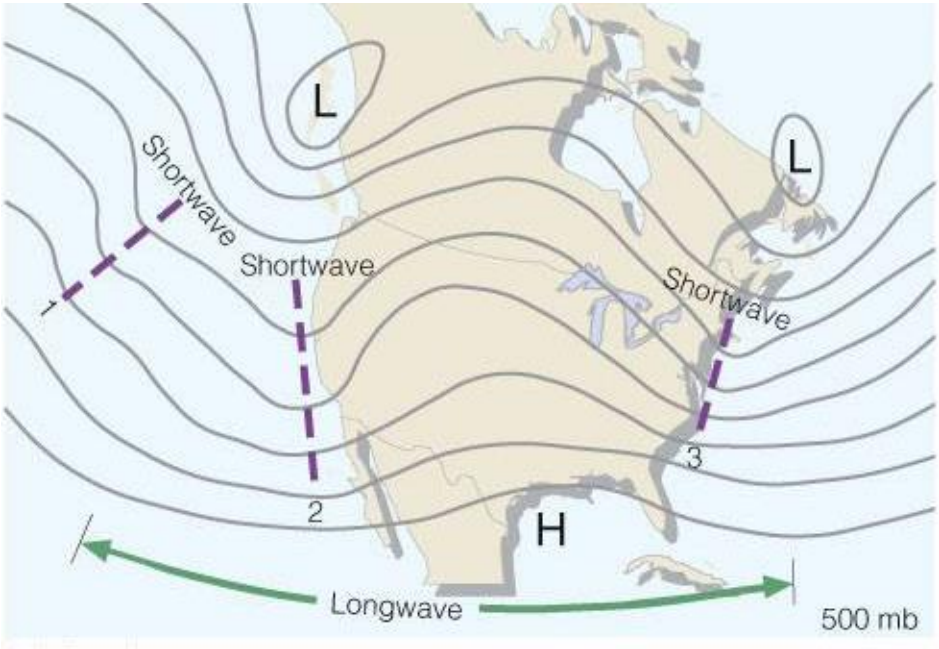
Longwaves

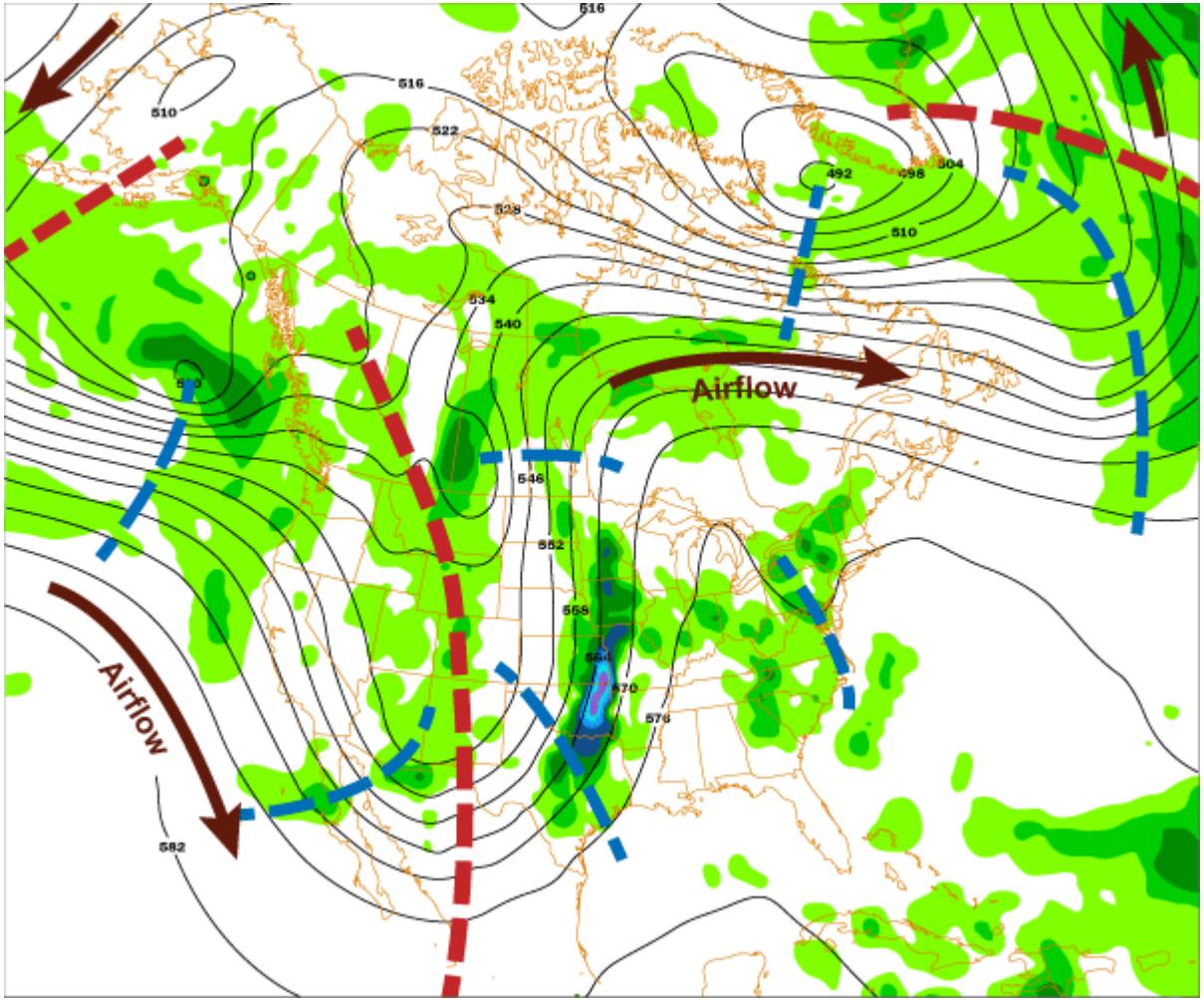
- **Long waves** - are a fundamental feature on an unevenly heated rotating spherical planet.
- Referred to as Rossby waves
- Usually are 4-6 of them around the globe at a given time
- Wavelength varies between 4000-8000 km
- Generally stationary - or move very slowly east or west



Shortwaves

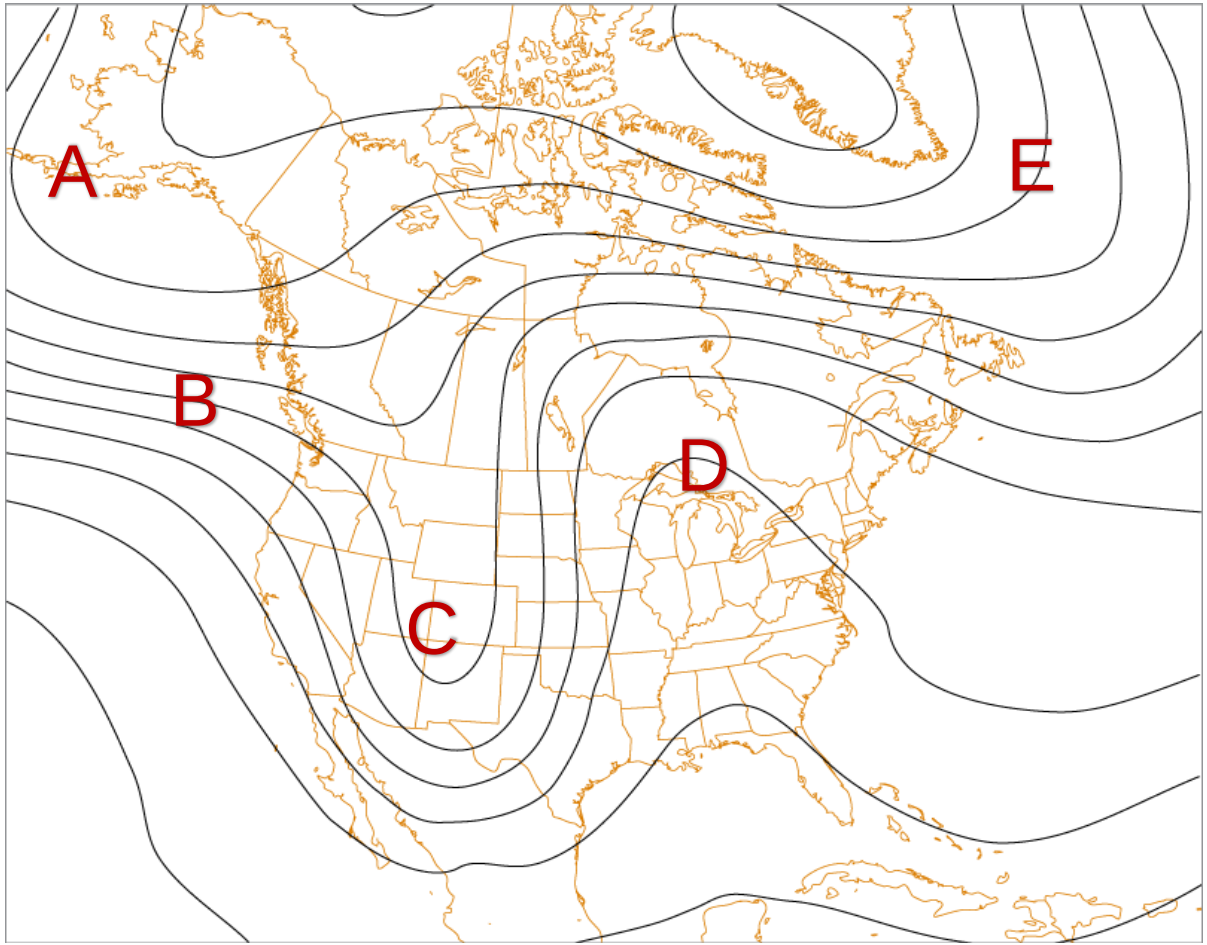
- "piece of energy"
- Short waves (short wave troughs)
- Move quickly to the east
- Weaken when move to a long-wave ridge
- Strengthen when they move to a long-wave trough
- Short waves are readily observable at mid levels (500 mb chart)





This is an example of a 500 mb chart. The height contours are in black. The brown arrows indicate direction of airflow. The large red dashed lines represent the location of the long wave troughs.
The shorter blue dashed lines represent the location of the of the more prominent shortwaves. (There are more short waves than indicated.)
The green areas represent precipitation totals. The areas of precipitation are mainly associated with shortwaves as they pass through longwaves.

Identify a Trough



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Identify a Trough

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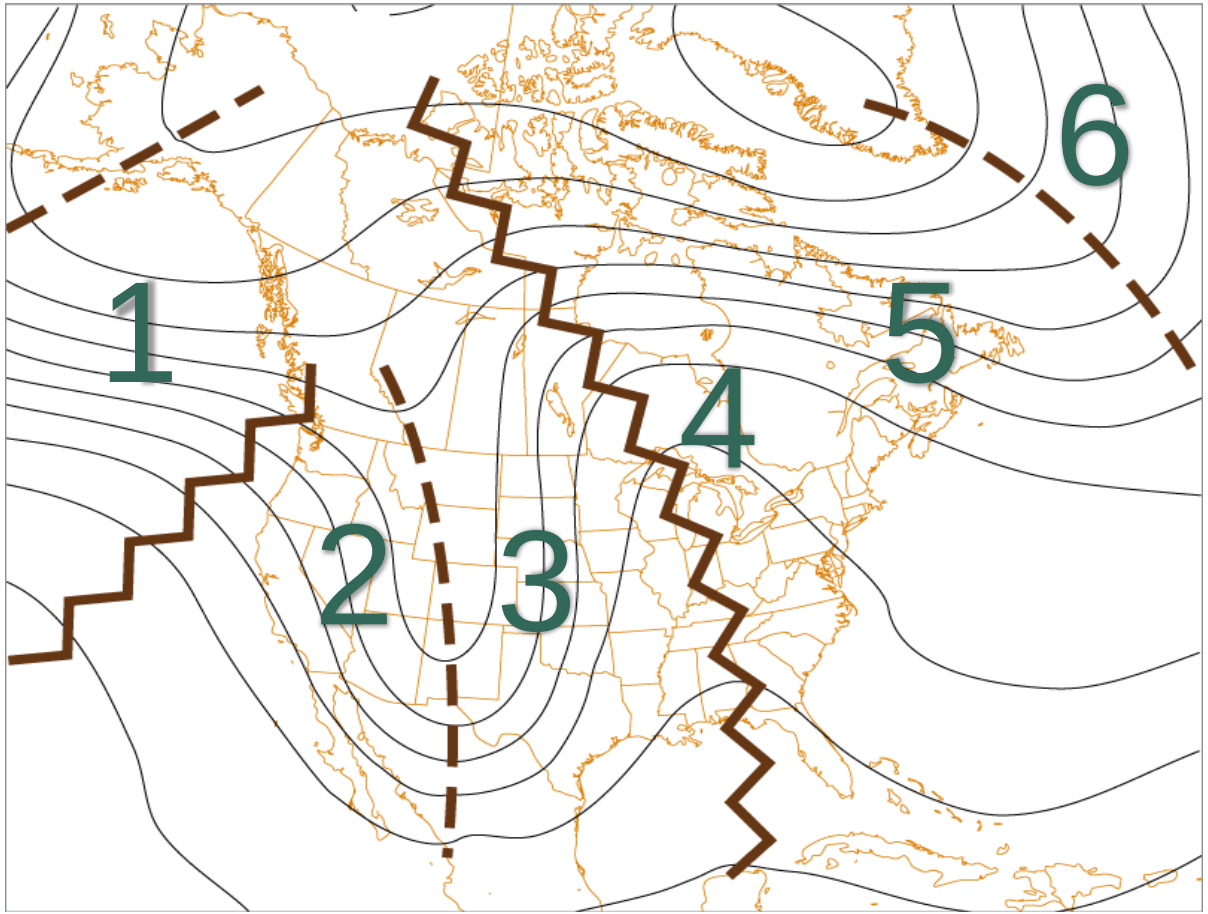
Areas of active weather ?



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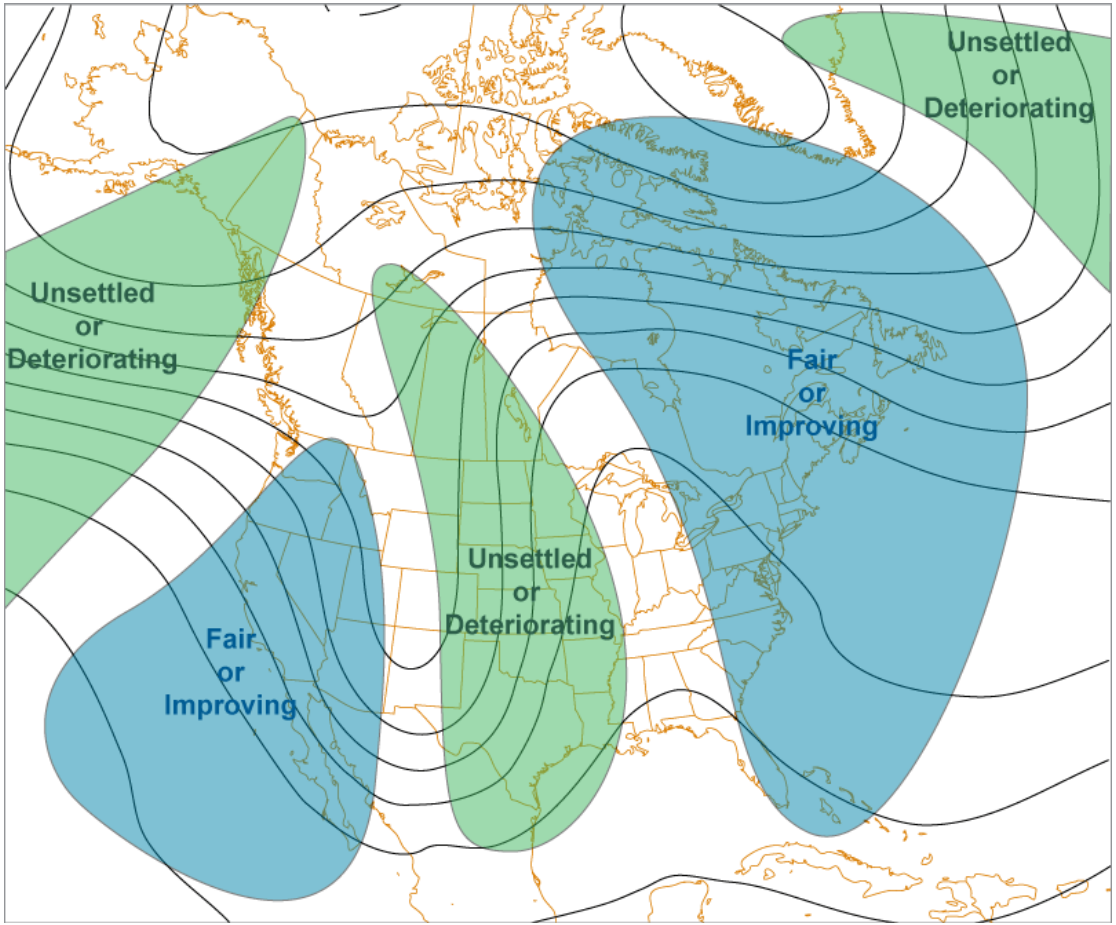
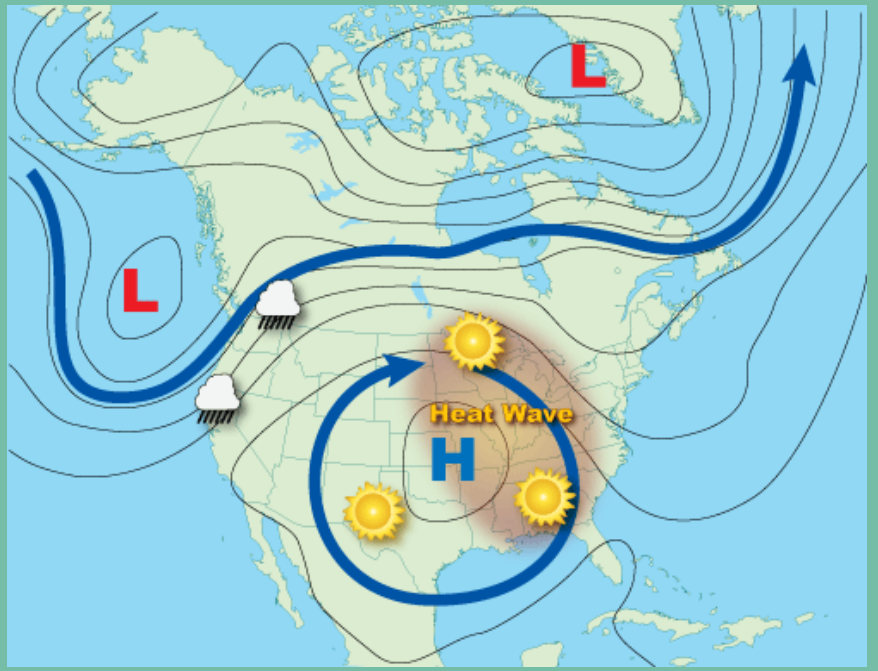
Areas of active weather

ⓘ Start presenting to display the poll results on this slide.

greater wind speed ?

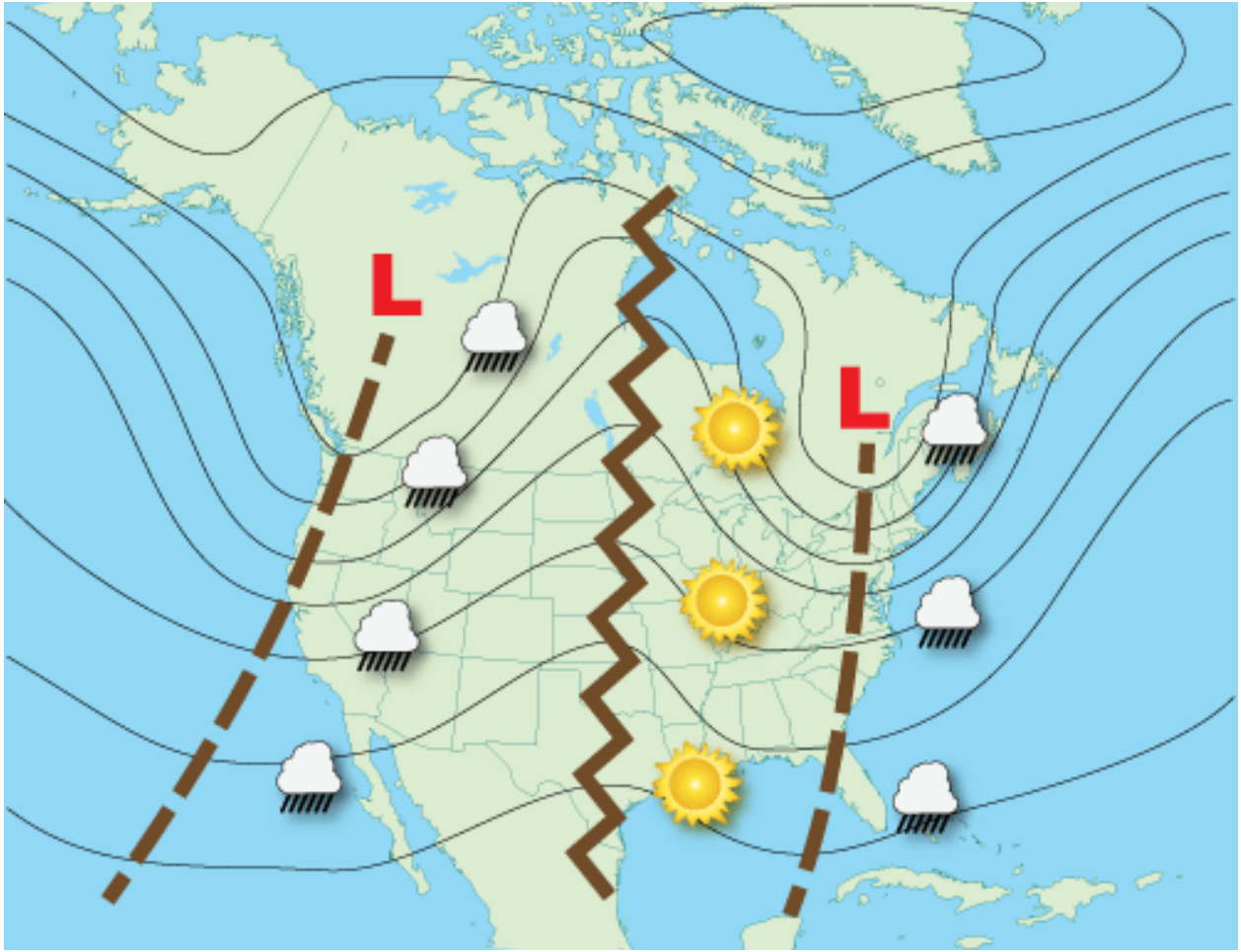


Basic Wave Patterns



Open Waves

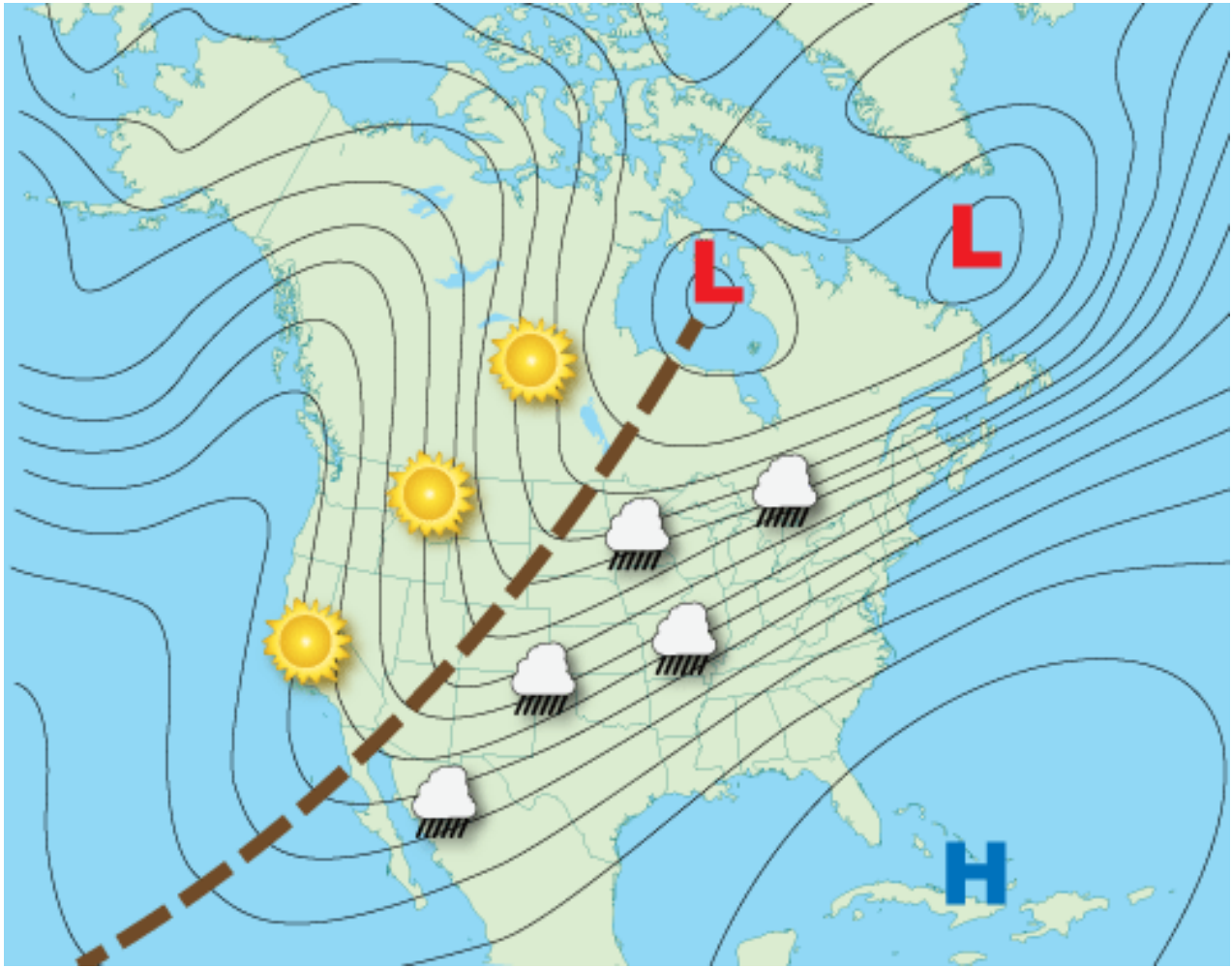
- These waves and troughs are considered 'open' as, for the most part, there is no closed circulation associated with the waves.
- They are progressive meaning they move from west to east.



Positive Tilted Troughs

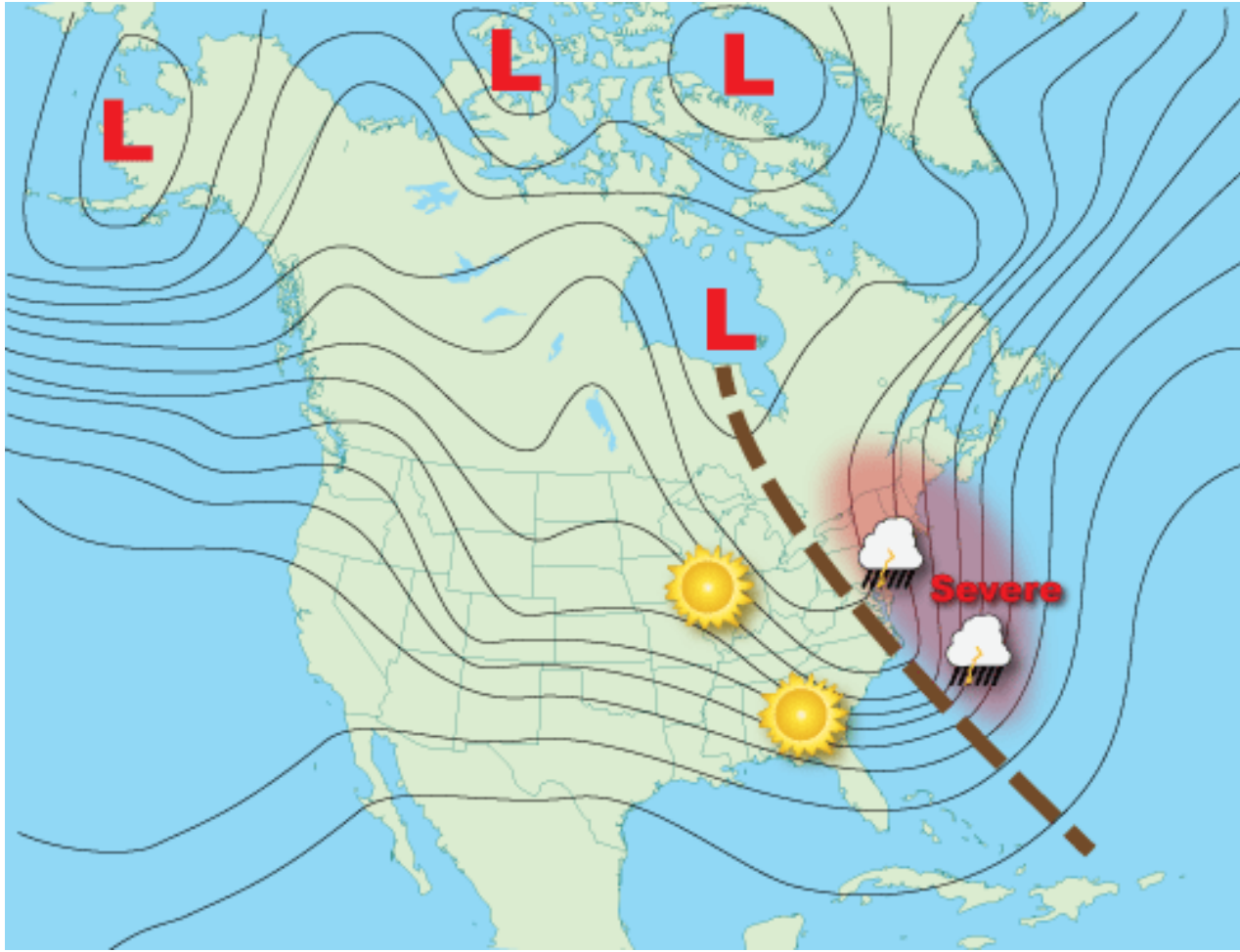
- Positive tilted troughs will extend from the lowest pressure northeast to southwest in the Northern Hemisphere (southeast to northwest in the Southern Hemisphere).

- In respect to severe weather, positive tilted troughs produce the least amount.



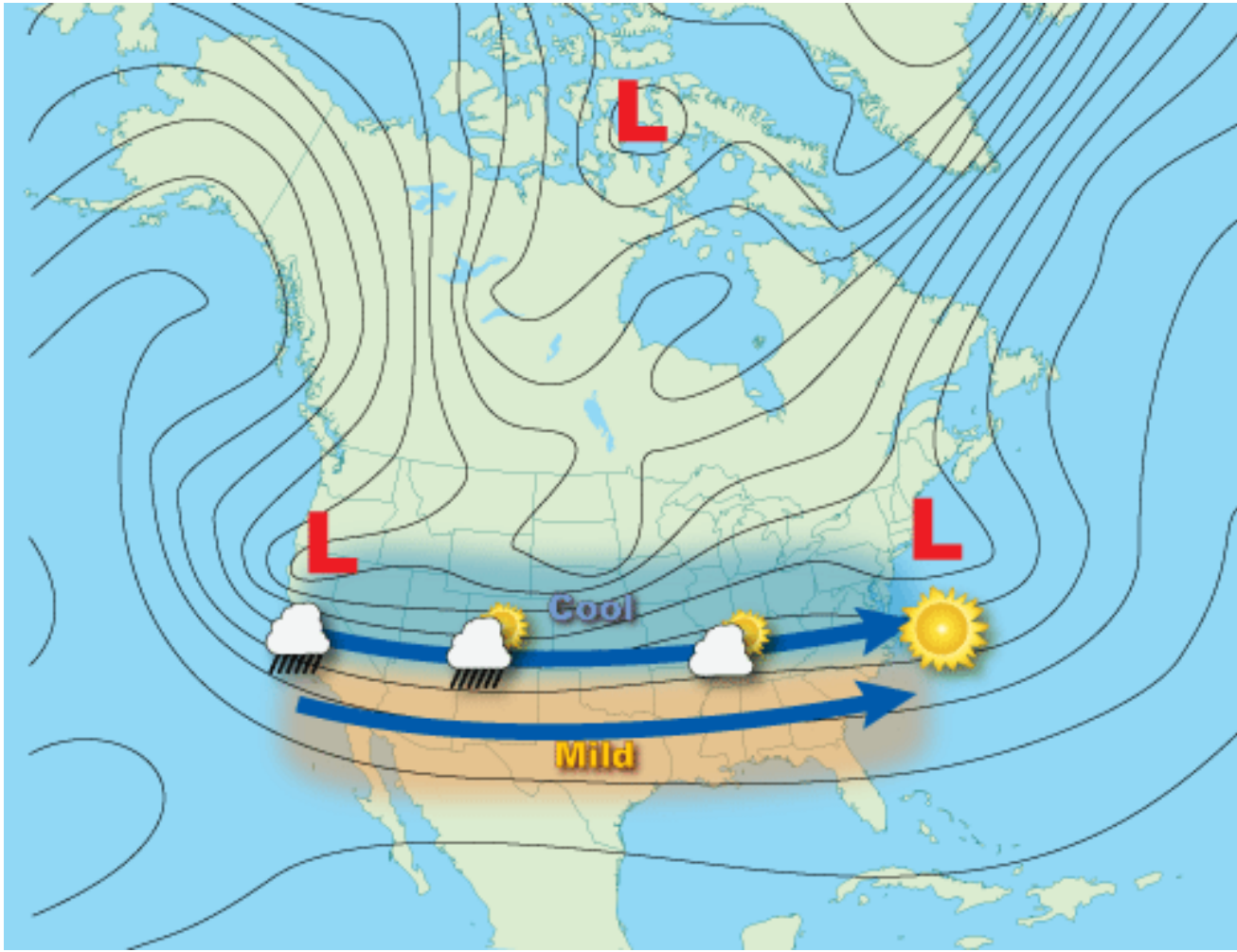
Negative Tilted Troughs

- Negative tilted troughs usually begin as positive tiled troughs. As the short-wave energy races east though the longwave it distorts its shape from positive to neutral (north-south) orientation to a negative (northwest to southeast) orientation.
- These types of troughs produce the most severe weather.



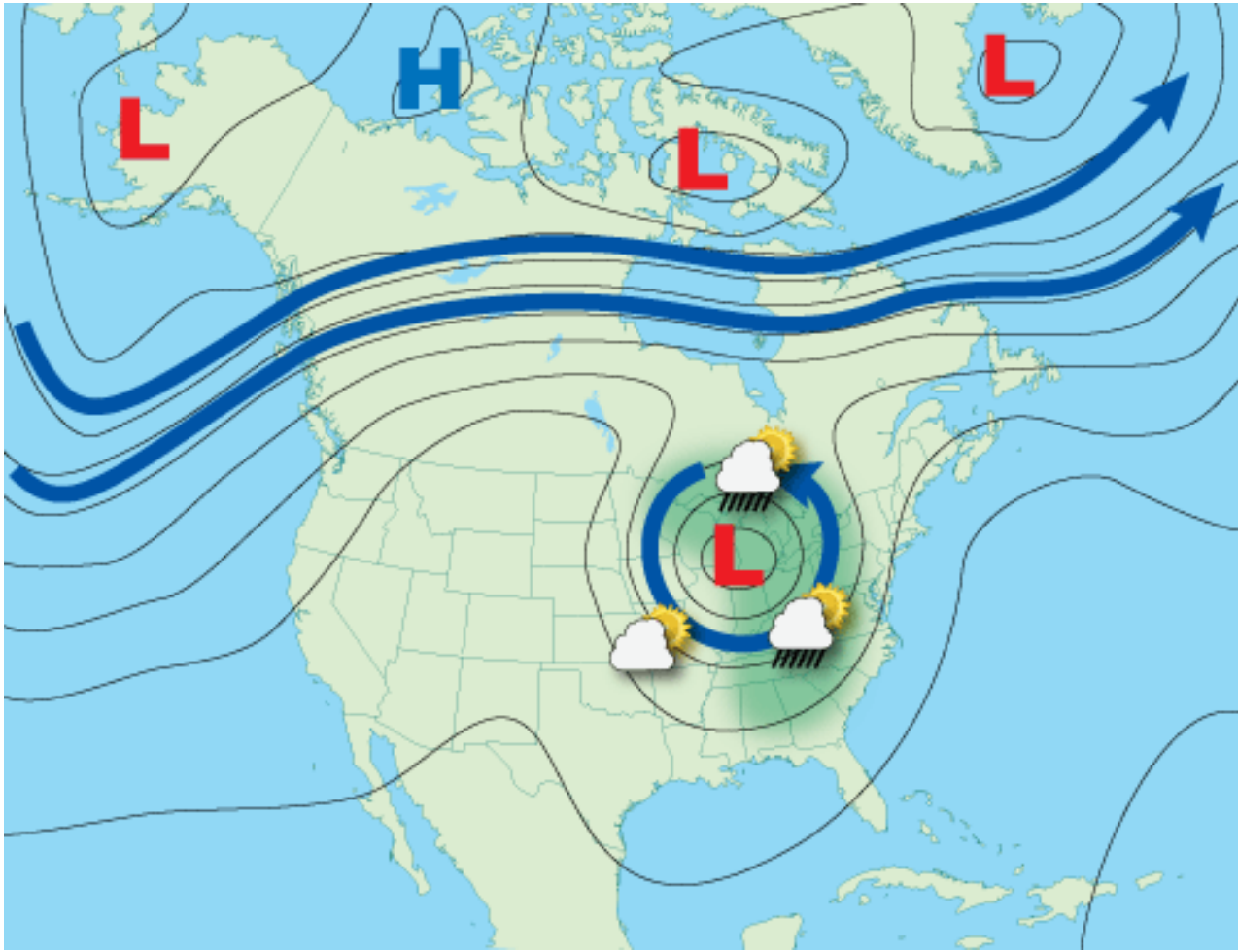
Zonal Flow

- When the air flow is parallel (or nearly parallel) to the latitude lines then it is considered to be a zonal flow.
- As a result, locations to the pole-ward of a zonal flow will remain cool or cold, while equator-ward, the weather remains mild or warm. Usually there is a positively and negatively tilted trough at each end of zonal flow.



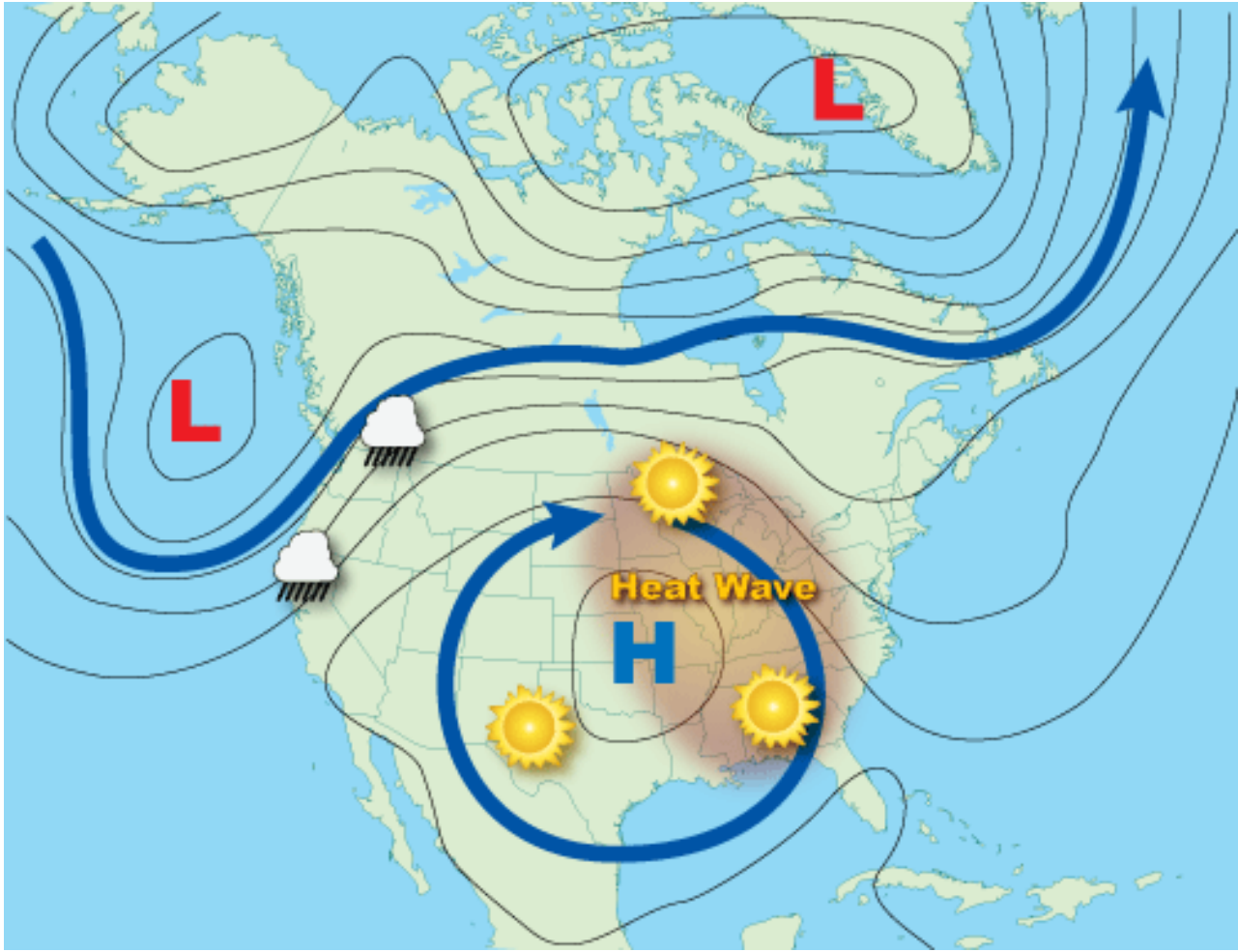
Cut-off Low

- These are persistent low-pressure areas that have become isolated or 'cut-off' from the main airflow.
- Unsettled weather occurs over the eastern half of cut-off lows though there can be some precipitation wrapping around the north end of the low affecting the northwest quadrant.



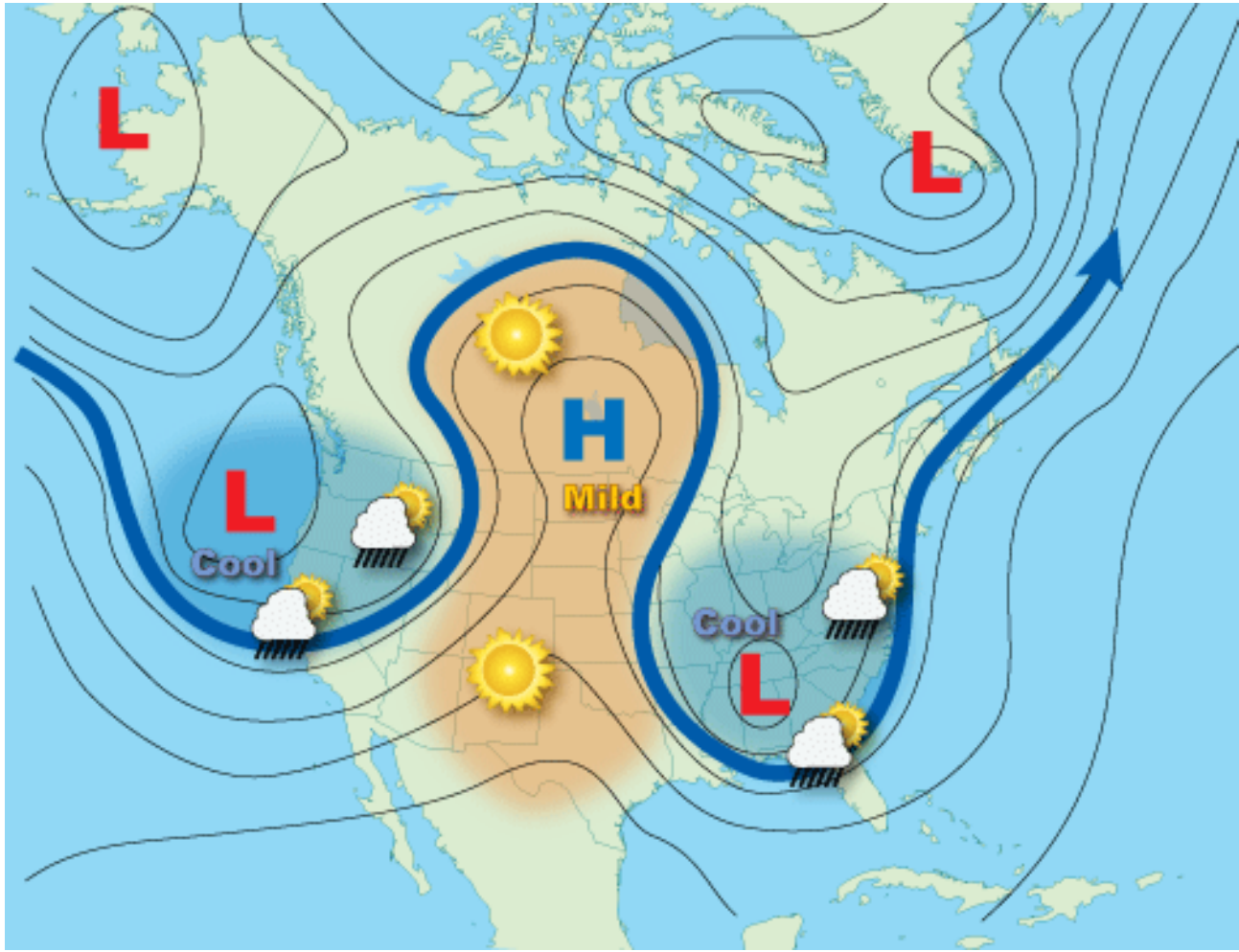
Blocking High

- Typically, a summertime occurrence, blocking highs are responsible for major heat waves.
- The skies are usually clear due to the downward motion of air. Eventually blocking highs will weaken when a short wave moves over the top of the high causing it to decrease with an end to the heat wave.



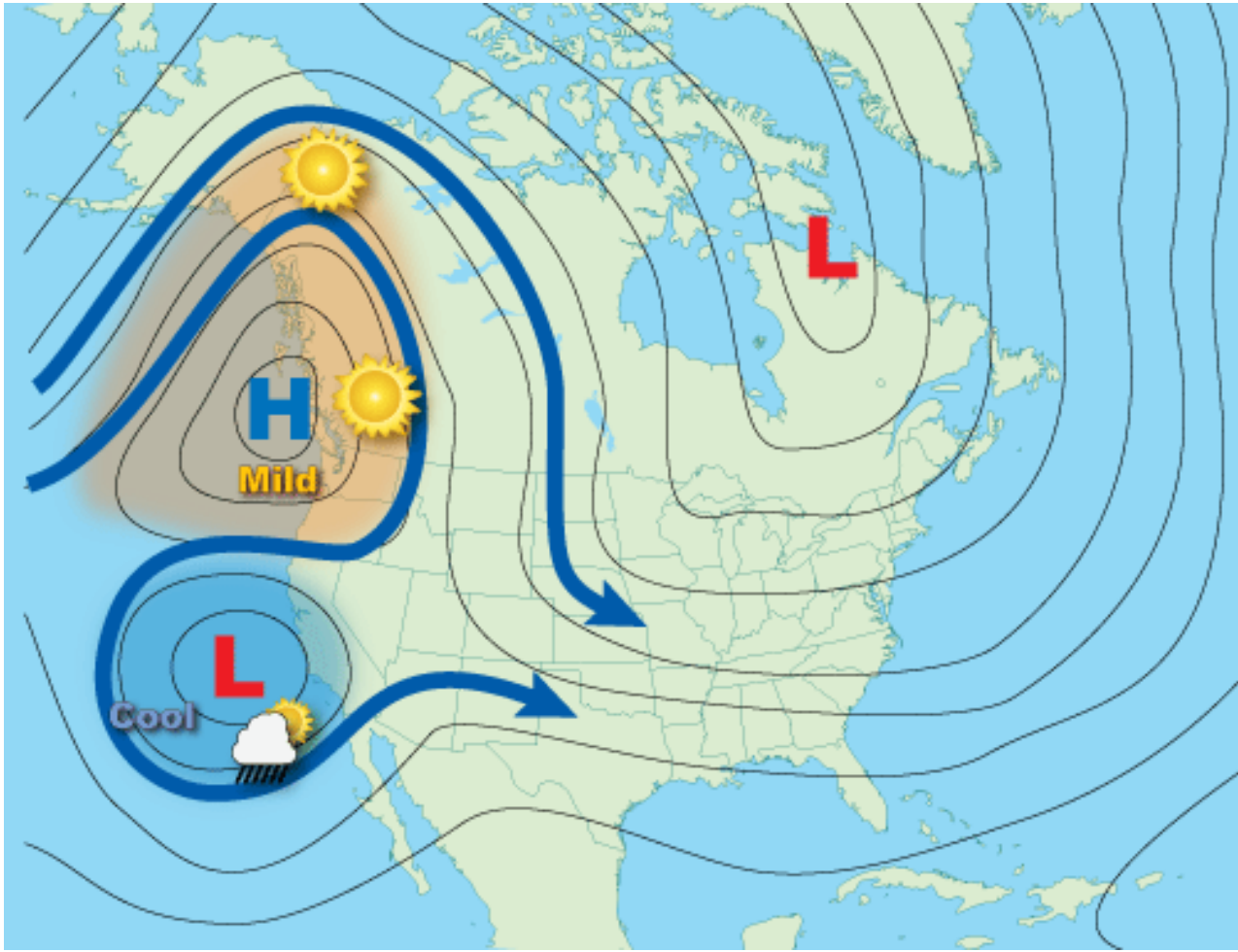
Omega Block

- Omega blocks are a combination of two cutoff lows with one blocking high sandwiched between them.
- Omega blocks are often quite persistent and can lead to flooding and drought conditions depending upon one's location under the pattern. Cooler temperatures and precipitation accompany the lows while warm and clear conditions prevail under the high.

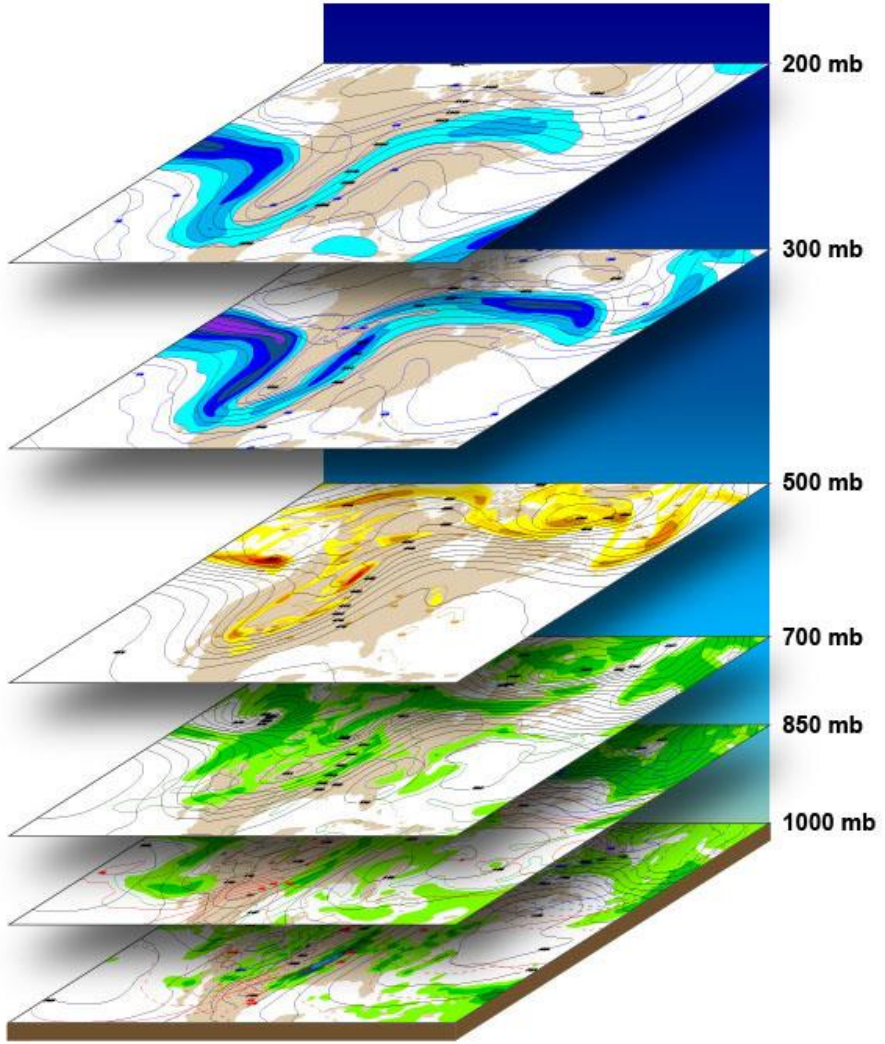


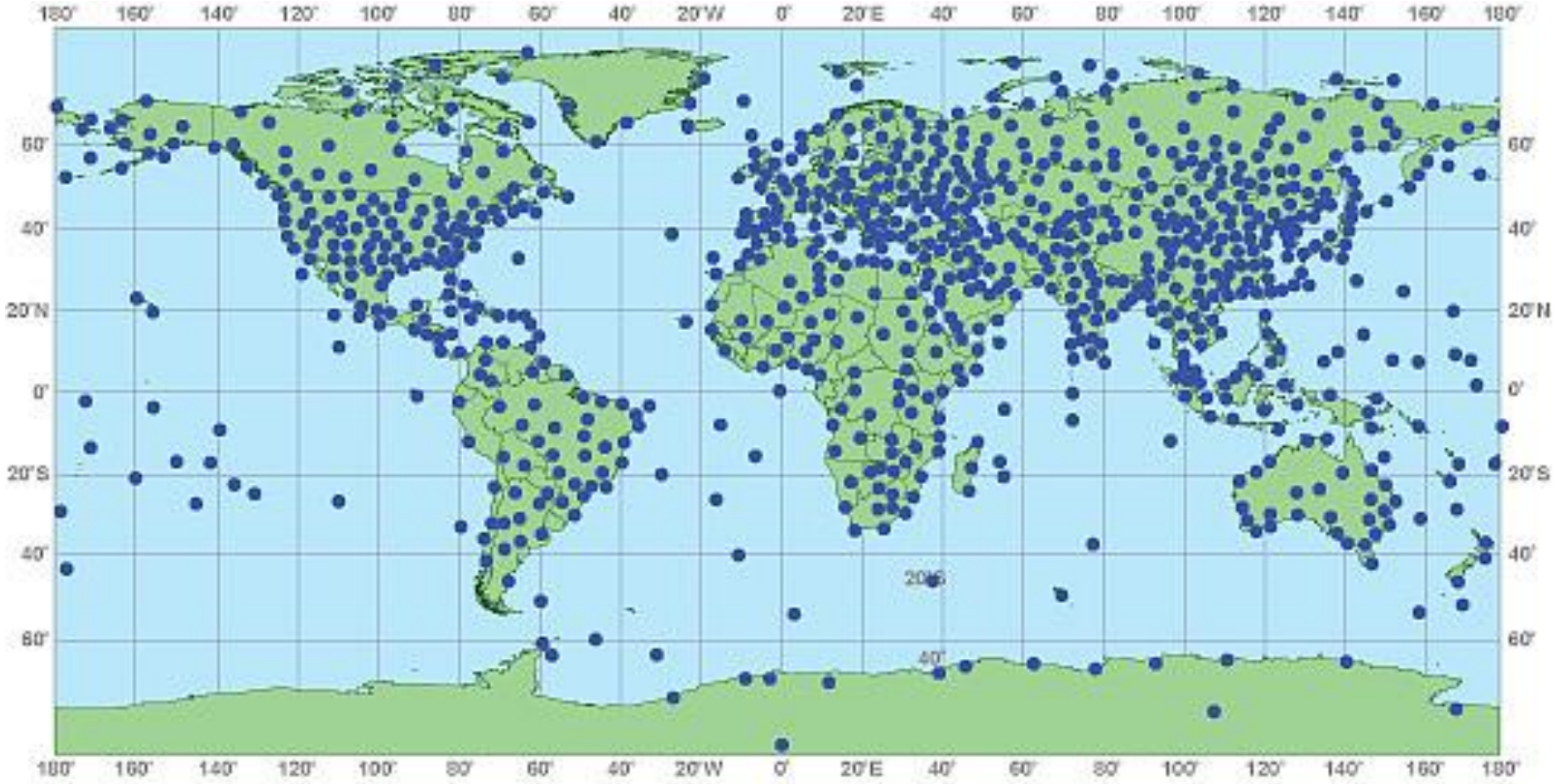
Rex Block

- Rex blocks are characterized by a high-pressure system located pole-ward of a low-pressure system. The Rex block will remain nearly stationary until one of the height centers changes intensity, unbalancing the high-over-low pattern.
- Unsettled, stormy weather is usually found near the low pressure while dry conditions are typical with the high-pressure.



Constant Pressure Charts




180° 160° 140° 120° 100° 80° 60° 40° 20°W 0° 20°E 40° 60° 80° 100° 120° 140° 160° 180°
60°
40°
20°N
0°
20°S
40°
60°

THE 300 / 200 MB CHART

WHAT TO LOOK FOR ON 300/250/200 chart:

(1) Jet stream

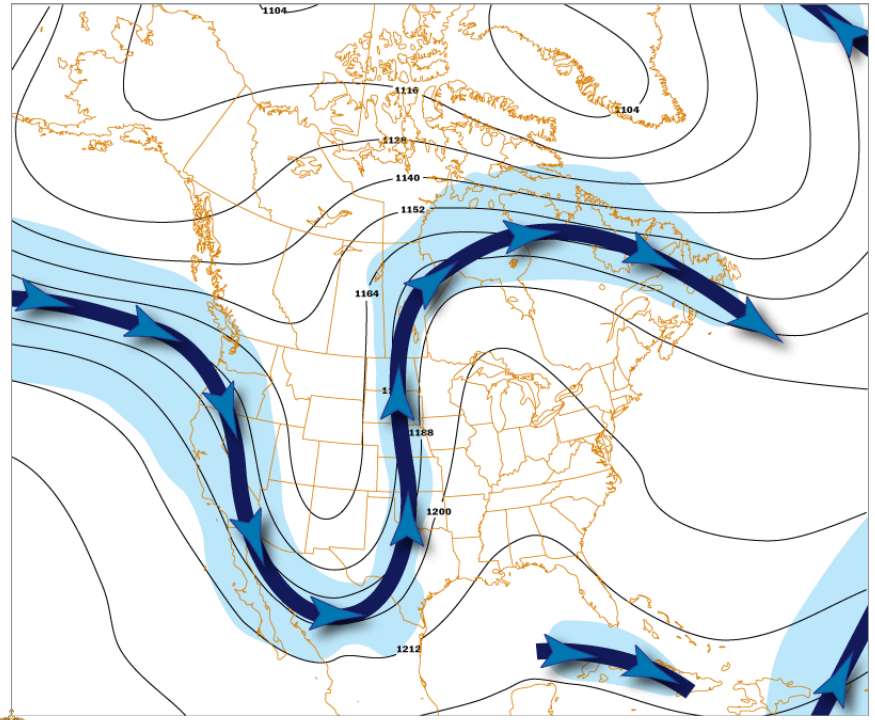
*The jet stream is a river of air with segments of higher speed winds embedded within the mean flow

*Areas North of jet stream tend to have cooler than normal temperatures especially in the mid-latitudes

*Areas South of jet stream tend to have warmer than normal temperatures, especially in higher latitudes

(3) General trough/ridge pattern

*Momentum of jet stream carves the trough ridge pattern. If the jet stream winds are greater on the LEFT side of a trough, the trough will become more amplified and move further south. If the jet stream winds are greater on the RIGHT side of a trough, the trough will become less amplified with time and move further north



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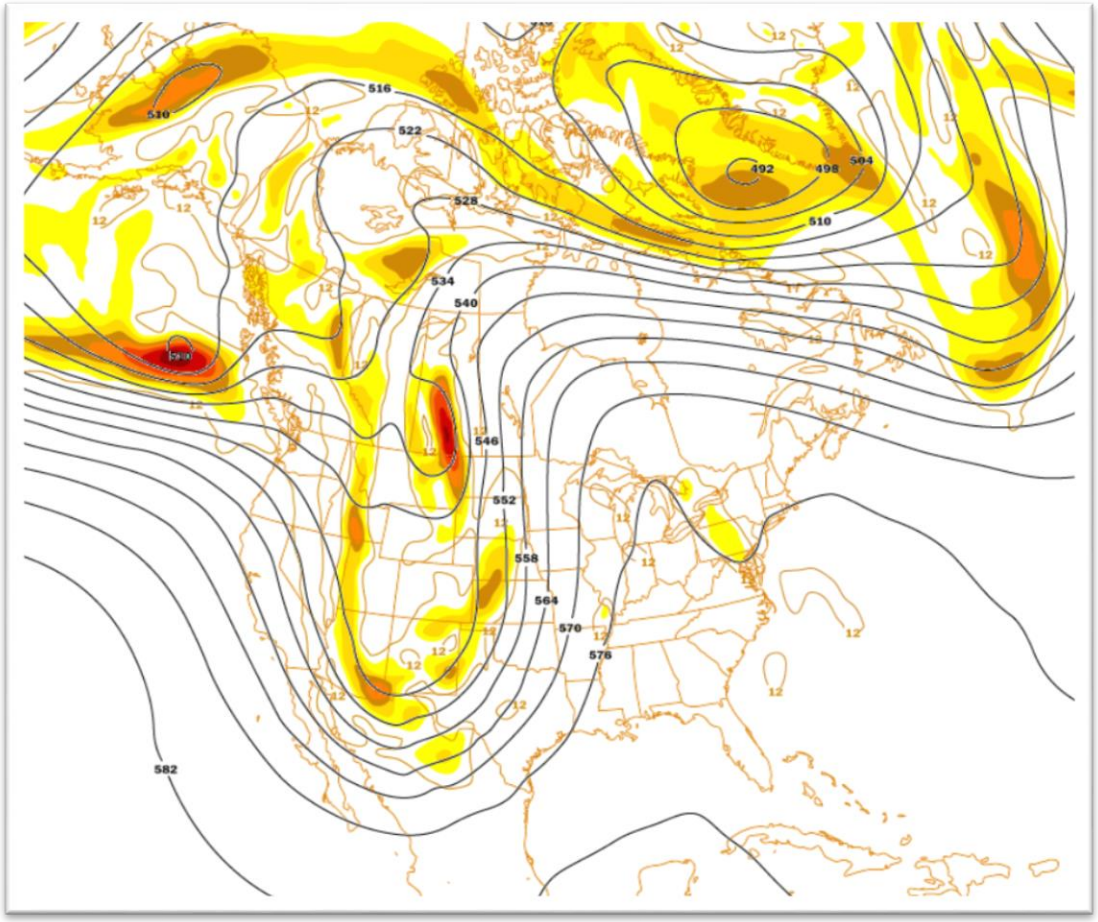
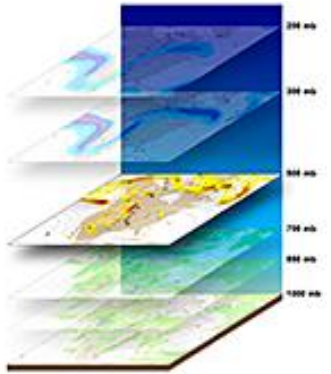
Constant Pressure Charts: 500 mb



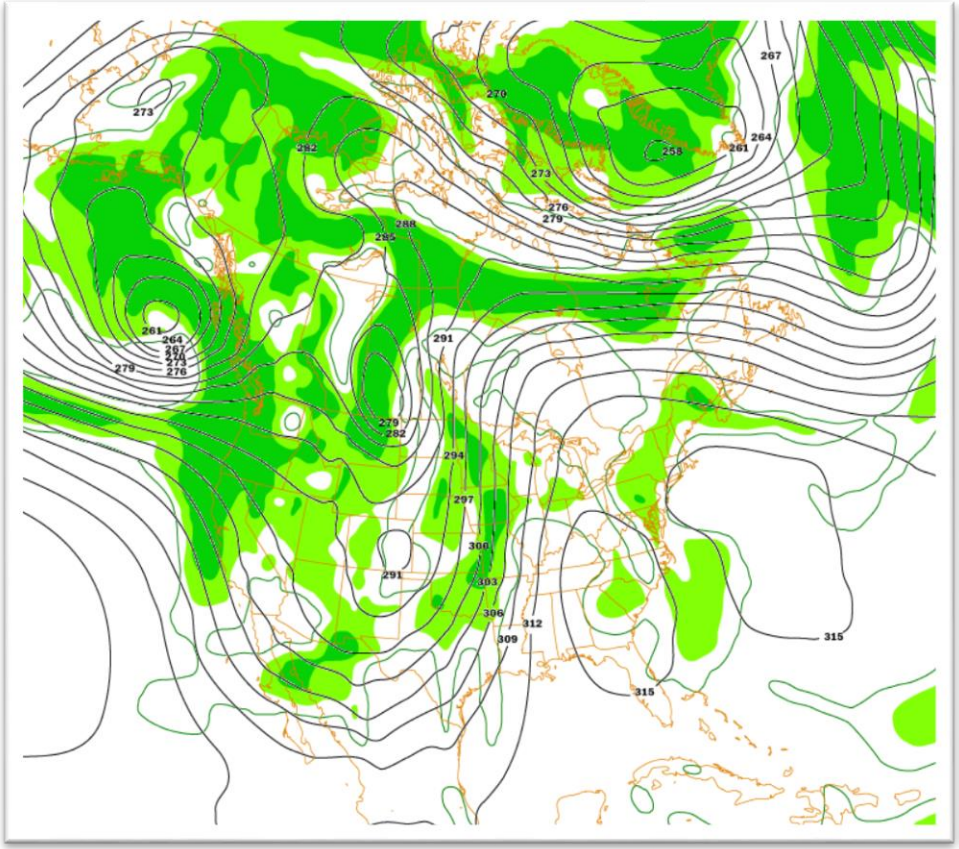
Constant Pressure Charts: 500 mb

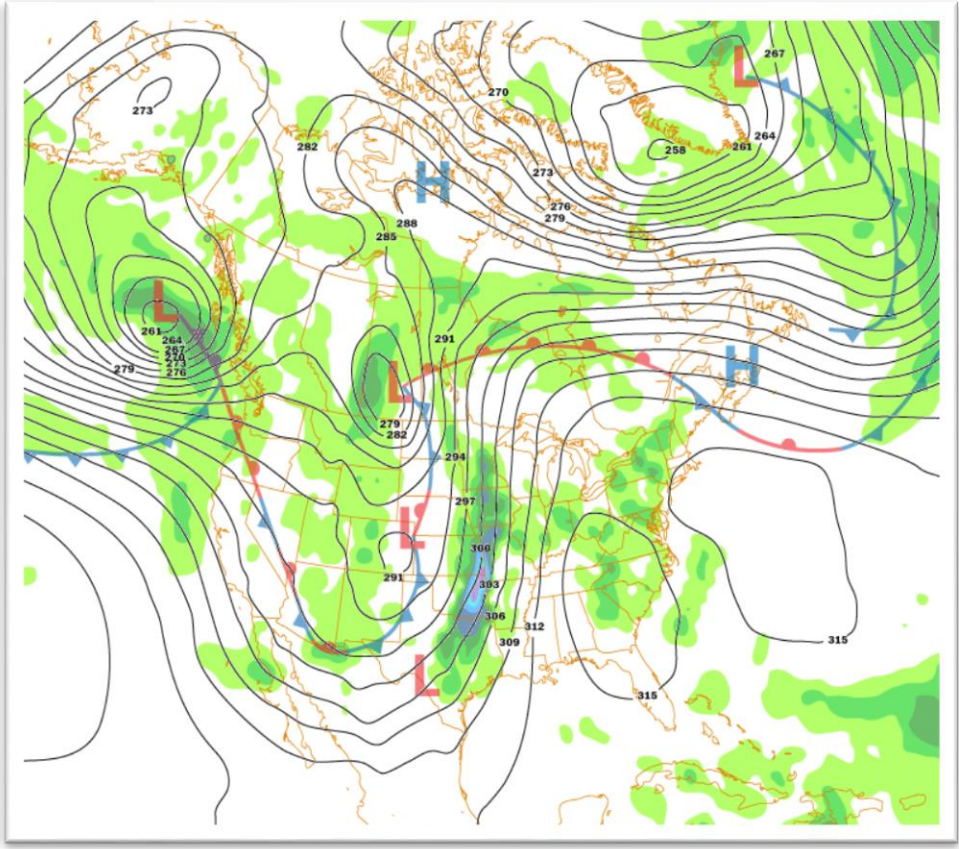
WHAT TO LOOK FOR:

- (1) This is the best chart to assess the magnitude of vorticity.
- (2) This is the best chart in assessing the trough/ ridge pattern .
- (4) Temperatures at 500 mb are rarely above 0 degrees Celsius.
- (5) Look for shortwaves within the longwave flow.



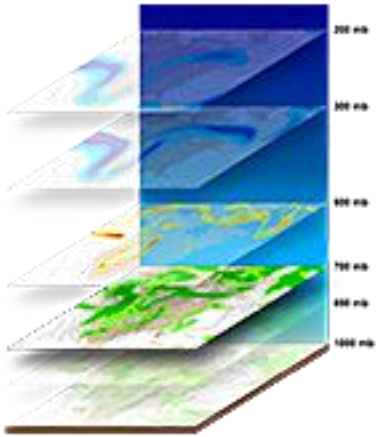
Constant Pressure Charts: 700 mb



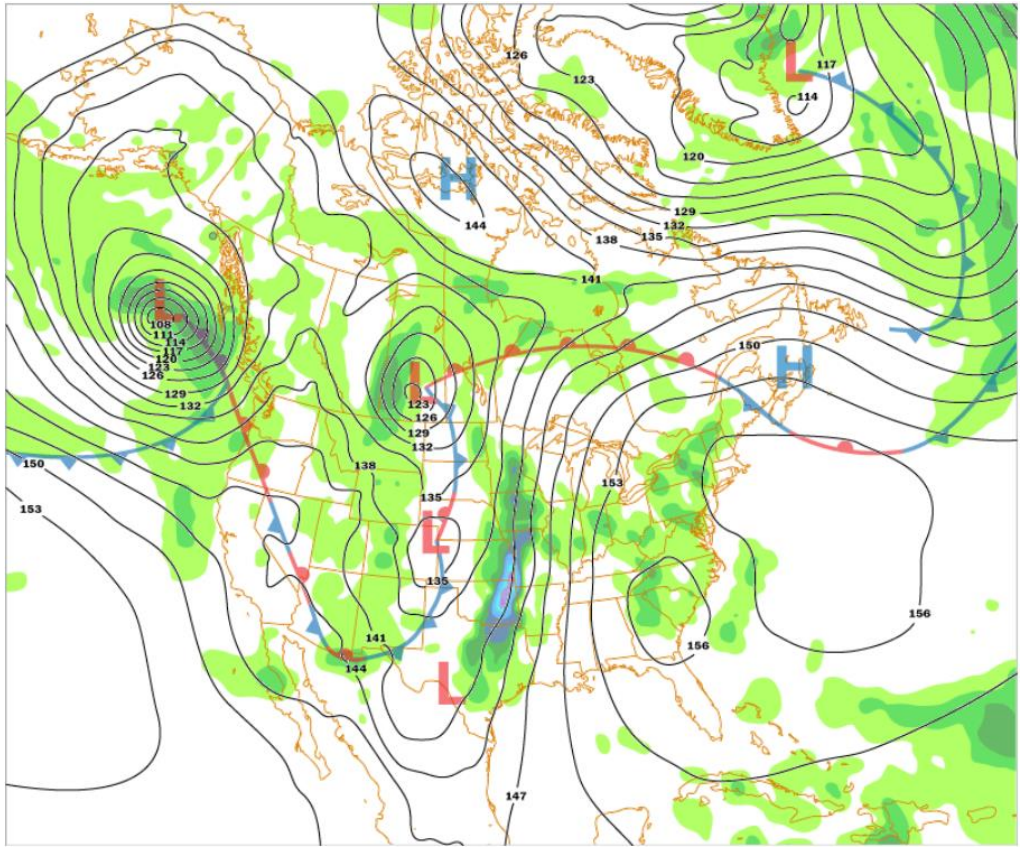


Constant Pressure Charts: 700 mb

- **WHAT TO LOOK FOR AT 700 MB:**
  (1) Find areas with low dewpoint depressions.
  (2) Determine strength of warm air advection, cold air advection, and moisture advection.
  (3) Determine strength of high pressure/ low pressure.
  (4) Locate shortwaves.
  (5) Weather is warmer than normal under ridges and cooler than normal under troughs.
  (6) Look for the greatest height falls and height rises.
  (7) 700 mb front is found where height contours kink.



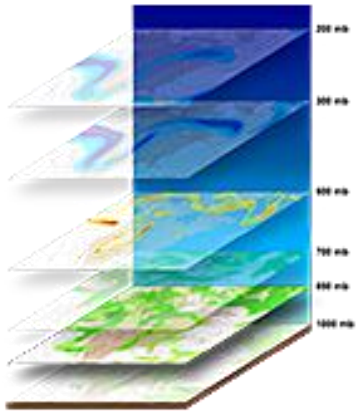
Constant Pressure Charts: 850 mb



Constant Pressure Charts: 850 mb

WHAT TO LOOK FOR AT 850 MB:

- Convergence, divergence, confluence, and diffluence.
- Watch for height falls and height rises. Low pressure tends to develop toward the greater height falls. Height rises indicate low pressure is leaving or a ridge is building.

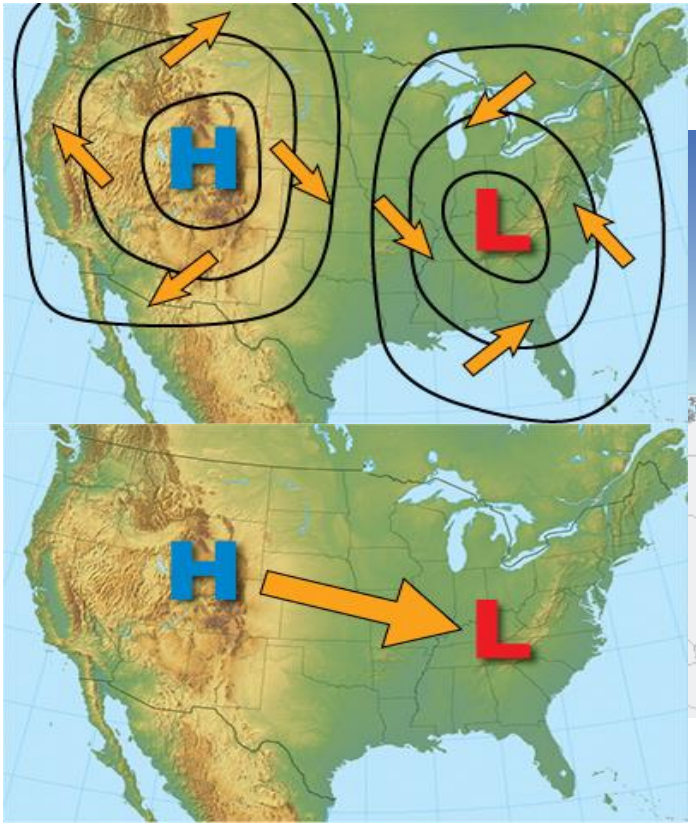


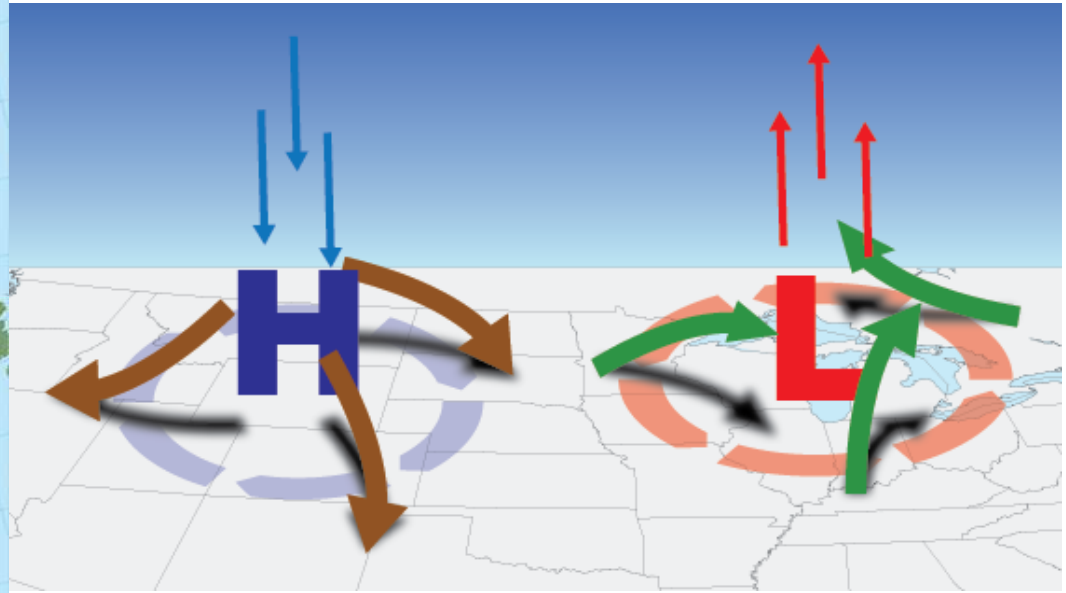
THE SURFACE CHART

THE SURFACE CHART

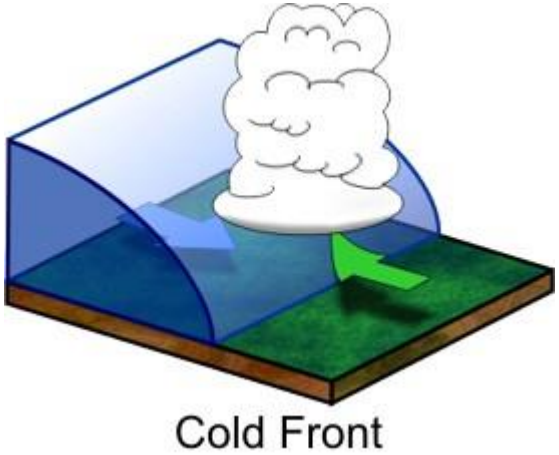
- Many more observation sites than on upper air charts
- More frequently updated than upper air charts
- Isobars are the solid lines (they are NOT height contours)
- Frictional force is significant on this chart. Turns wind about 30 degrees toward low pressure. This causes convergence into low pressure regions. Friction also causes wind to be more variable, especially when winds are below 10 miles per hour.
- Strong fronts will cause "kinking" of isobars

Origin of Wind

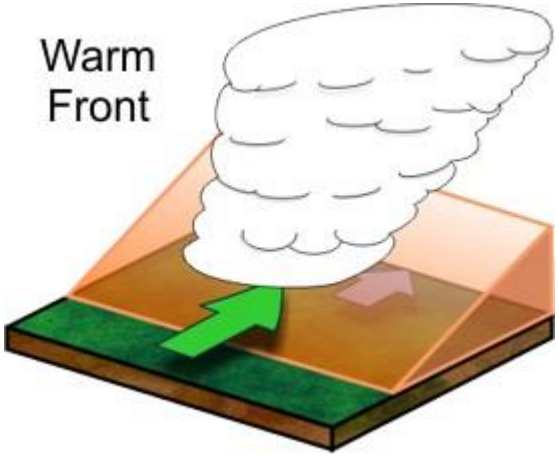




Air mass boundaries



Cold front, a colder air mass is replacing a warmer air mass.



Warm front, a warmer air mass is replacing a colder air mass.

Fronts

Cold Front

Warm Front

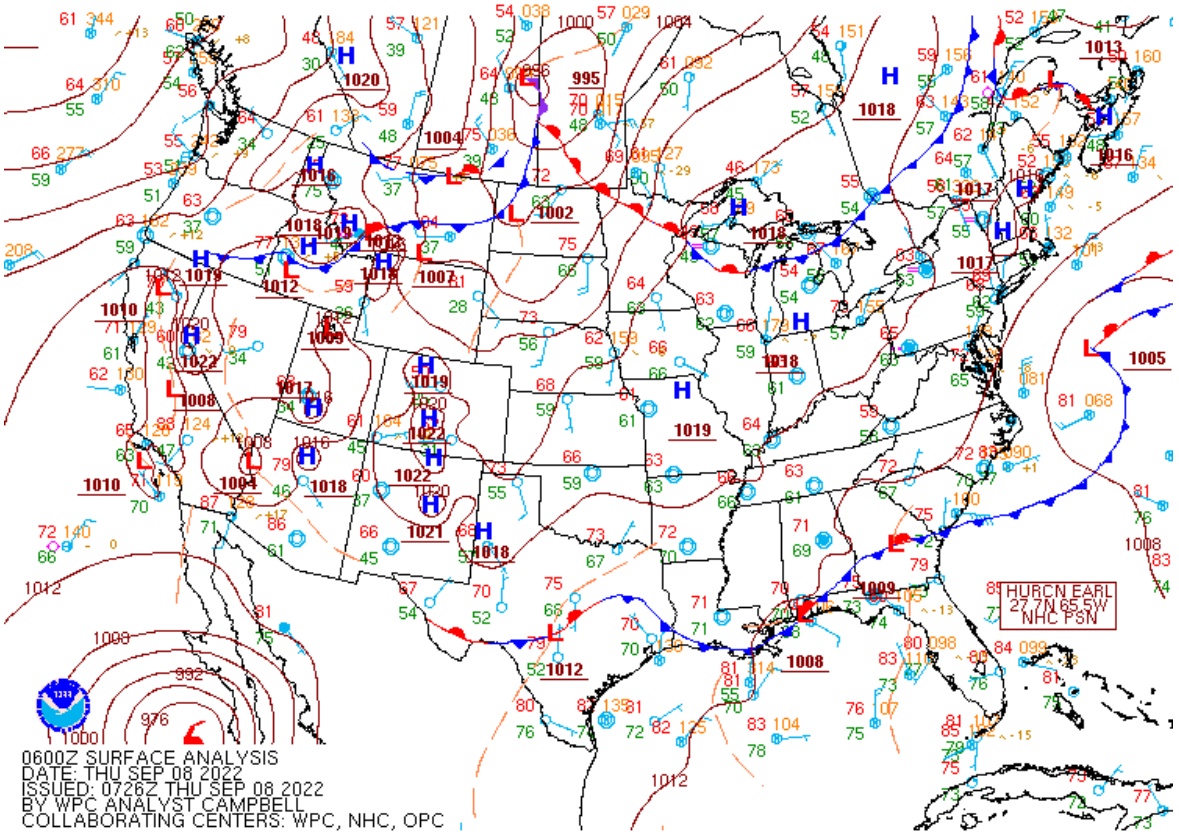
Stationary Front

Occluded Front

THE SURFACE CHART

WHAT TO LOOK FOR:

(1) Advections
(2) Fronts
(3) Pressure
(4) Convergence, divergence, confluence, diffluence
(5) Temperature and moisture gradients
(6) Influence of topography upon the weather conditions



Scan this

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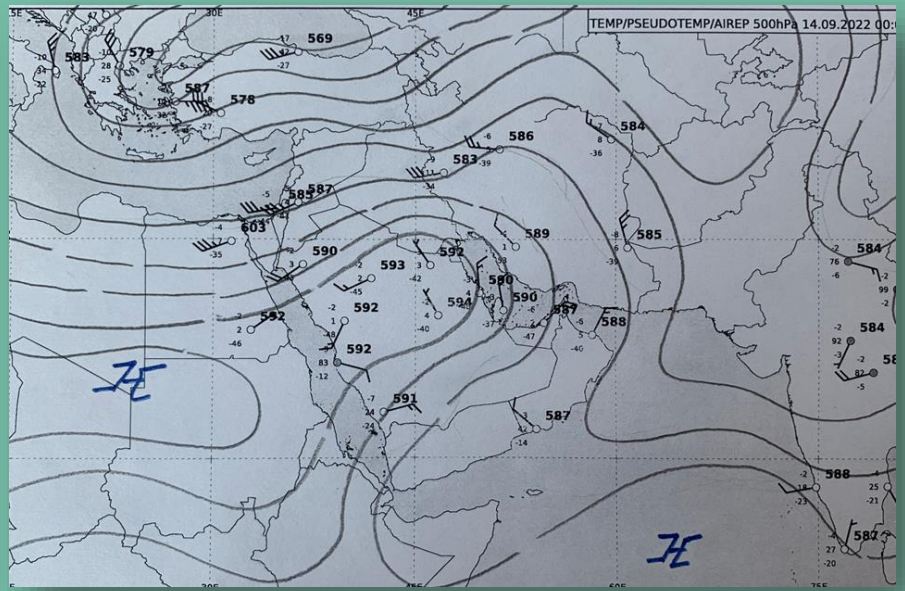
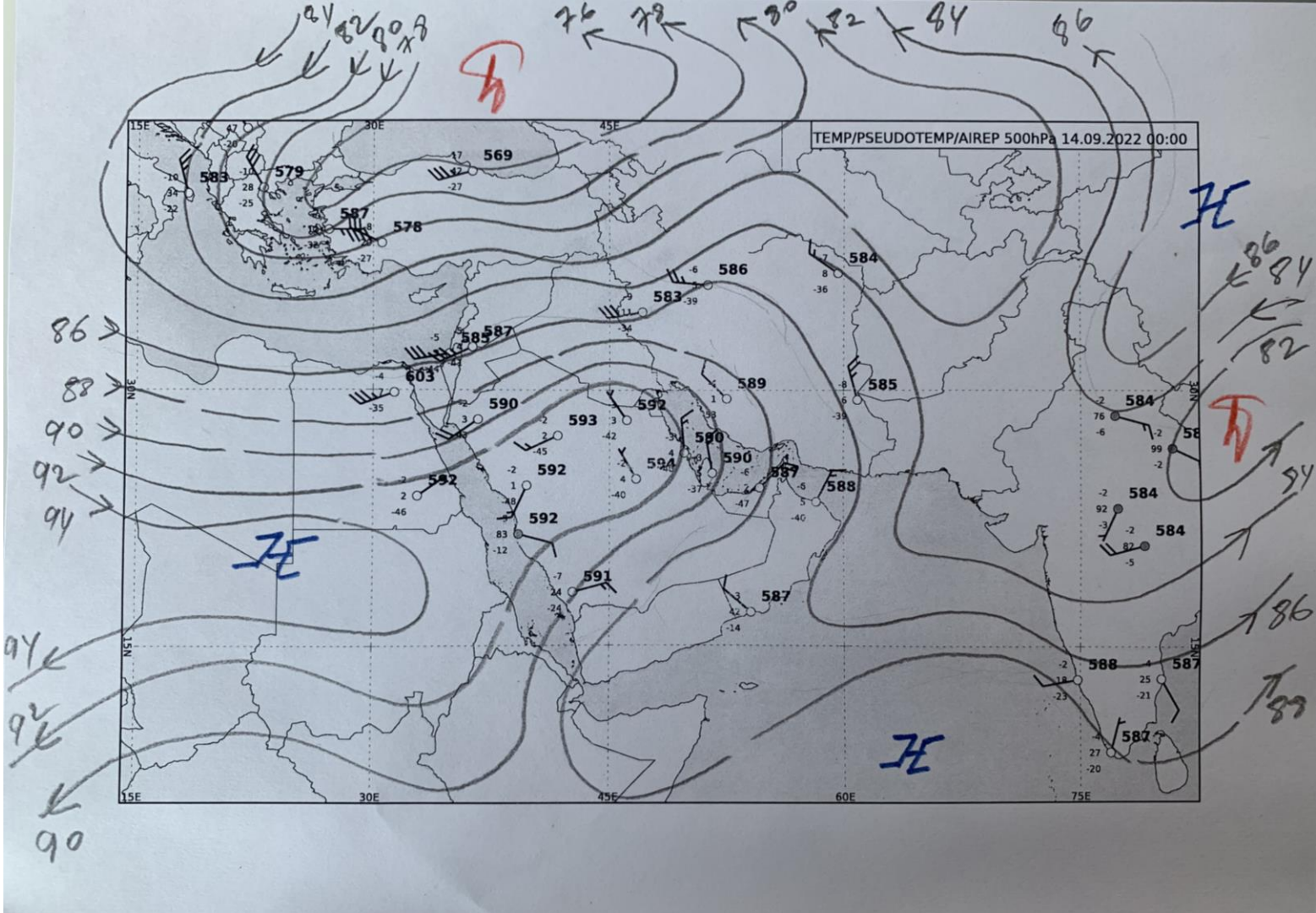
Thank You!

Chart Analysis



500hpa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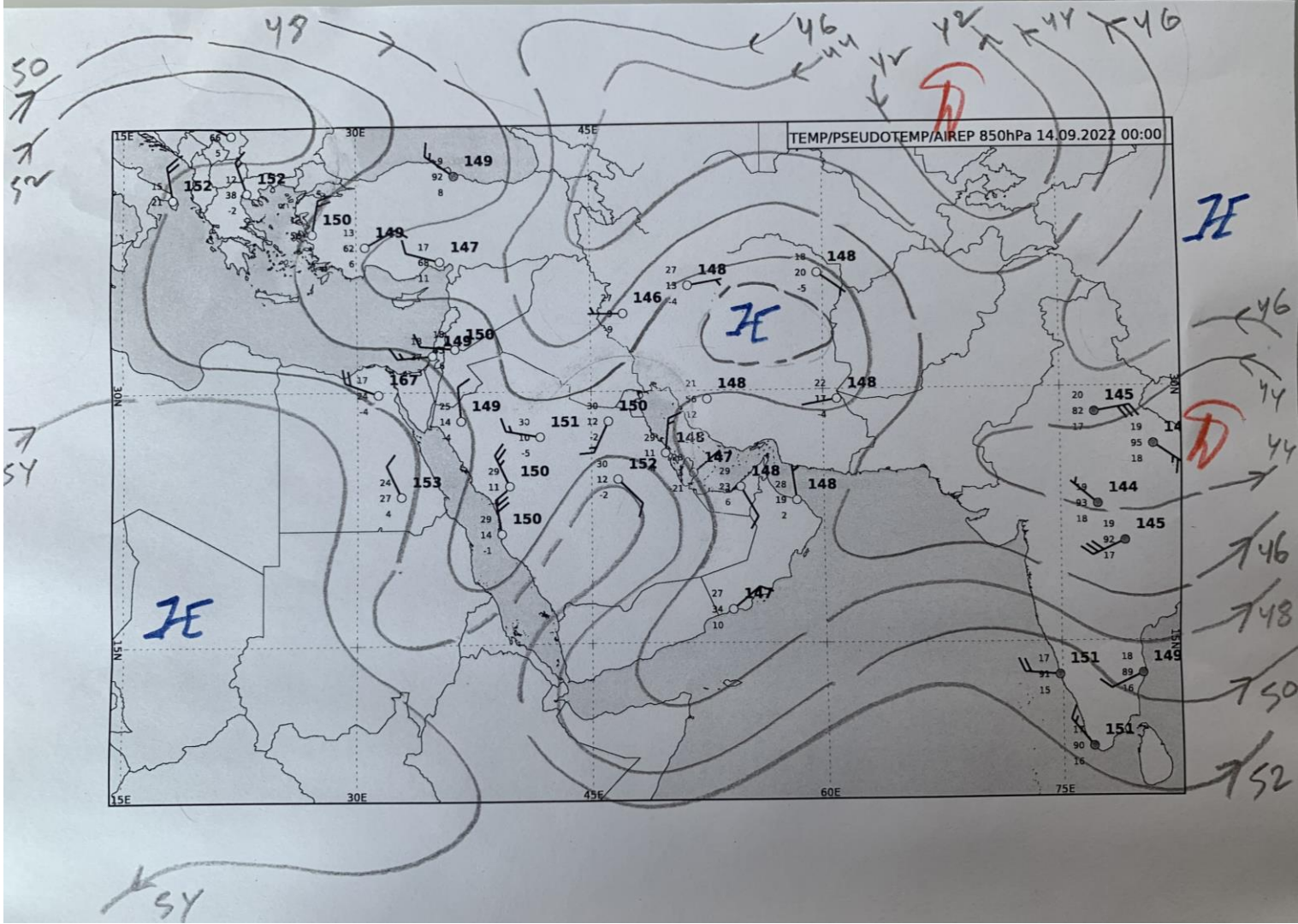
700hpa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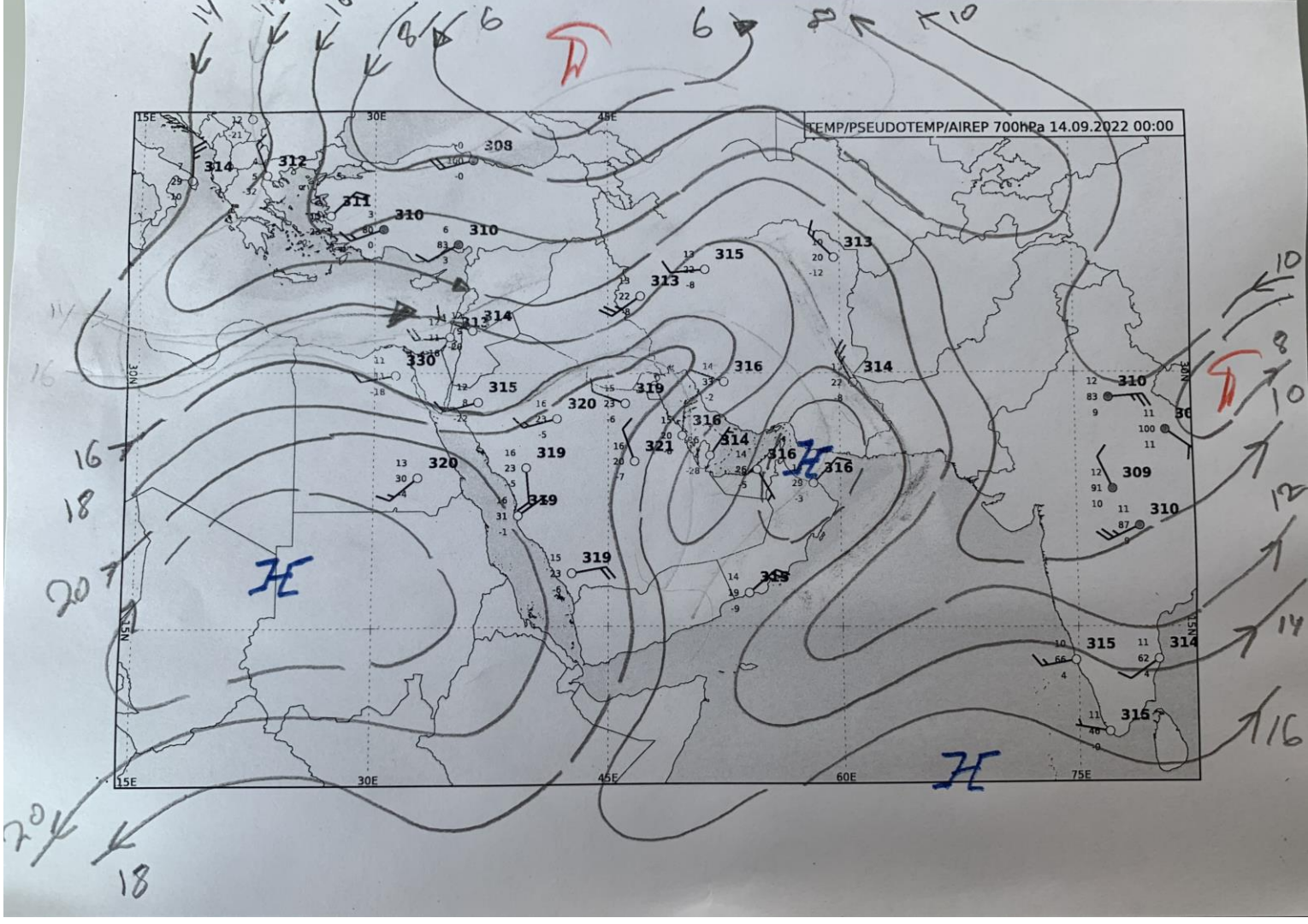
30N
15N

850hpa


TEMP/PSEUDOTEMP/AIREP 700hPa 14.09.2022 00:00
15E
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15N

THE SURFACE CHART

Scan this

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Thank You!