

# Soaring Weather Forecasting

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PASCO Safety Seminars  
November 2006

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# Presentation Points

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1. Weather Info Sources
2. Meteorology Points
3. Synoptic Scale  
Weather Patterns
4. Forecast Funnel
5. Contact Information

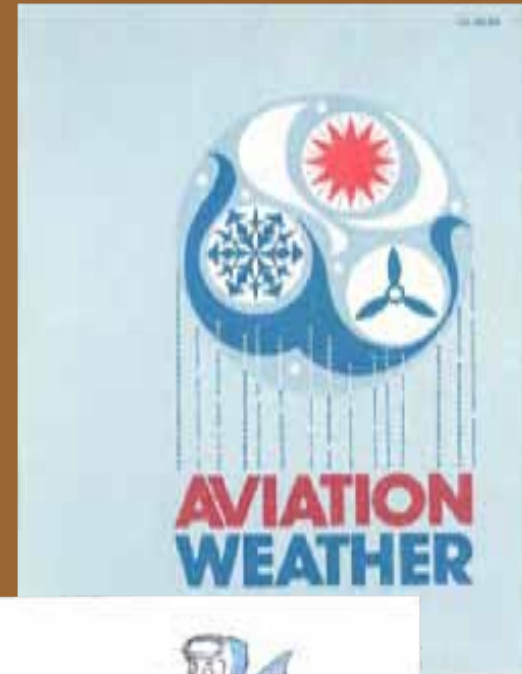


# 1. Weather Information Sources

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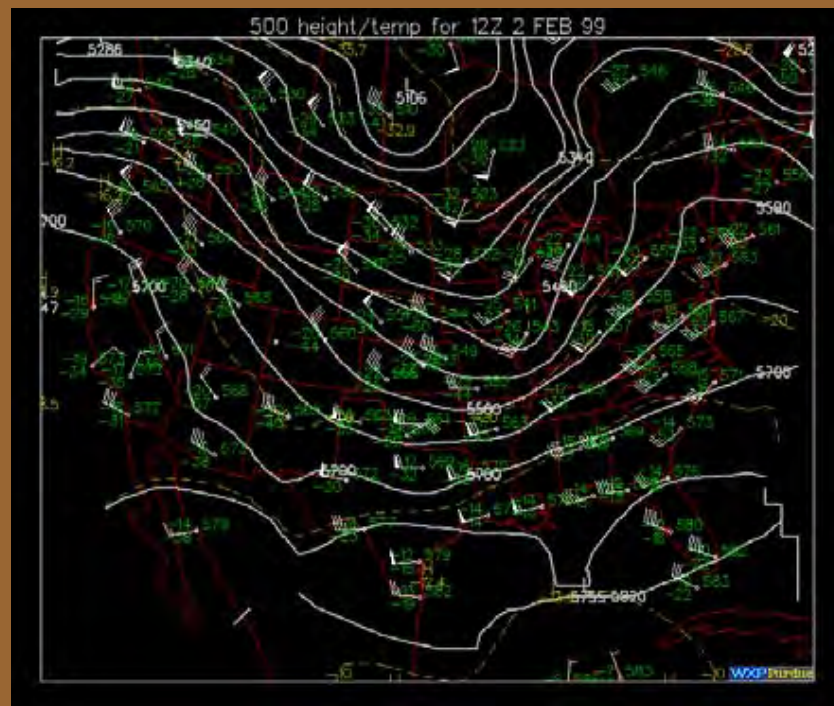
## Weather Data

- Internet (use “search engines”)
  - Site addresses change frequently
  - Customize access list for efficient data retrieval
- Review AC-006, Aviation Weather
- Review AC-45F, Aviation Weather Services



# Internet Weather Data

- Upper Air Temperature Soundings
- Observed and Forecast Weather Charts
- Model Forecasts
- Satellite Imagery



- Education / Explanations
- Soaring Category Info

# National Weather Service

[<http://www.weather.gov>](http://www.weather.gov)

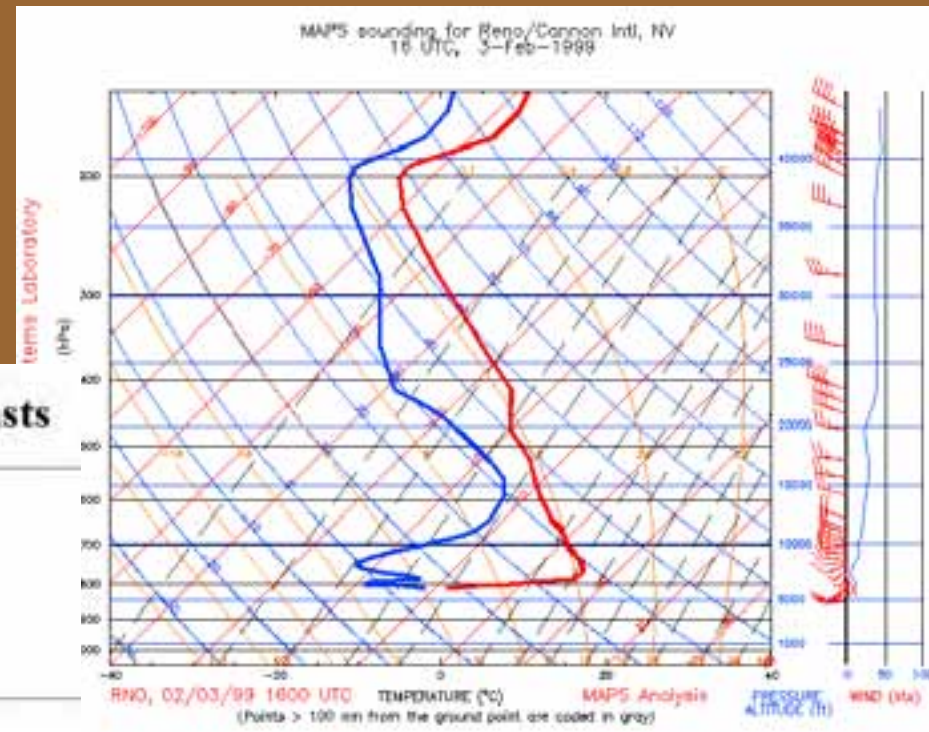
- NWS National Homepage
  - Select area of interest ('clickable' map)
- All Western Region NWS Offices listed
- Numerous weather links
  - Current weather
  - Forecast models
  - Satellite images
  - Aviation Wx Center
  - Other sites



# Forecast Systems Laboratory

<http://www-frd.fsl.noaa.gov/mab/soundings>

- Forecast Upper Air Temperature Soundings
- 40Km grid resolution
- Out to 16 Hours
- Spot forecasts  
(By airport)



## Plot sounding from [MAPS/RUC](#) Analyses/Forecasts

Input Data Source:  MAPS or  RUC-2

Input valid time -- year:  month:  day:  hour:  UTC

Location: Longitude:  , Latitude:  OR:

Airport ID:  (overrides lat/lon) ([list of airports](#))

-- OR --

Always get the latest MAPS sounding for a particular location.  
(Bookmark the following page)

Input Data Source:  MAPS or  RUC-2

Location: Longitude:  , Latitude:  OR:

Airport ID:  (overrides lat/lon) ([list of airports](#))

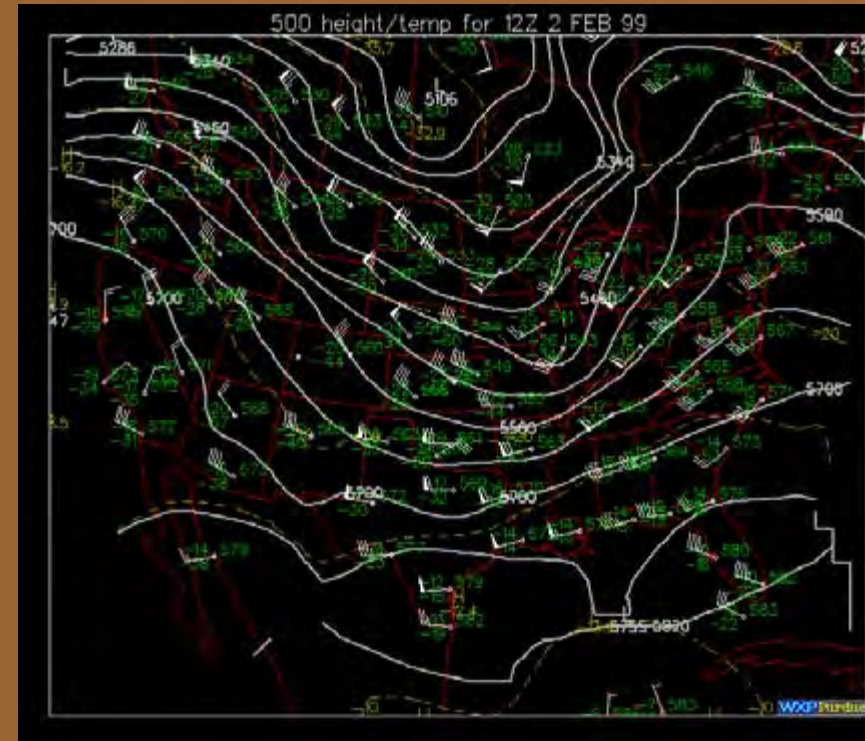
# Unisys Weather

<http://weather.unisys.com/index.html>

- Upper Air Temperature Soundings
- Constant Pressure Charts
- Model Forecast Charts
- Education / Explanations



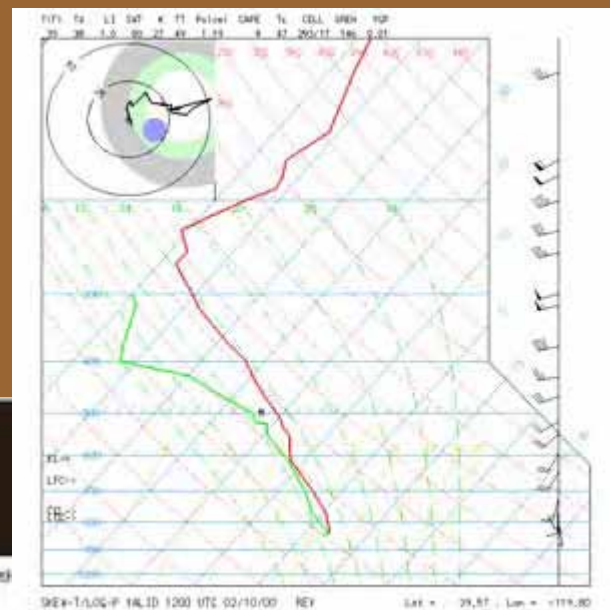
The screenshot shows the Unisys Weather website homepage. At the top left is the Unisys logo with the tagline "Imagine it. done." Below it are navigation links for "Unisys Home Page", "Unisys Transportation", "Weather Solutions", and "Unisys Weather". A sidebar on the left contains sections for "Home Information Contact", "Analyses" (with links for Satellite Images, Surface Data, Upper Air Data, Radar Data), "Forecasts" (with links for Model Statistics, NCM Model, NAM/ier Model, GE SAvn Model, GE SxMPL Model, NCM Model, and LCMPL Model), and "Miscellaneous" (with links for Illustrative Data, Archive of Images, and URG & Maps). At the bottom left is a search box for "Enter a zip code or city name to get forecast" with "GO" and "SETUP" buttons. The main content area features a "Unisys Weather" banner with a mountain image, followed by "ES7000 Servers True Flexibility" and logos for "unisys Internet Weather Data" and "unisys NOAA/PORT Solutions". Below this is a satellite and surface map of the United States, dated "19Z 01 NOV 06", with a "UNISYS" logo. At the bottom are links for "Visible Satellite Image", "Enh IR Satellite Image", "Satellite Surface Map", "US Radar Summary", "NAM Model Forecast", and "GF Sx 10 day Forecast".



# National Center for Atmospheric Research (NCAR) [et al.]

<http://www.rap.ucar.edu/weather/>

- Upper Air Data (Temp/RH/Wind Info)
- Other weather data



NCAR **RAP Real-Time Weather Data**  
The National Center for Atmospheric Research  
Operated by the University Corporation for Atmospheric Research

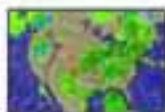
Home / RAP: **Weather Home** Satellite Radar Surface Upper Air Forecast



**Satellite**  
View cloud images as seen from space by geostationary satellites.  
[more >](#)



**Surface**  
See the surface weather conditions reported nearest you.  
[more >](#)



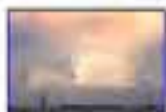
**Forecast**  
Become your own weather forecaster using these guidance tools.  
[more >](#)



**Radar**  
View reflectivity and velocity images from NEXRAD doppler radars.  
[more >](#)



**Upper-Air**  
See winds, temperature, and moisture well above the earth's surface.  
[more >](#)



**Help Pages**  
Review these pages for help interpreting certain graphics or to see what's new.  
[more >](#)

Enter Zip Code or City, ST:

**Local & Colorado**

Current conditions:  
Foothills • Mass • Webcam

- Regional air quality
- Boulder Forecast
- BCH Weather Cntr
- CoCoRaHS snow/rain
- CO discussions

**Severe & Tropical**

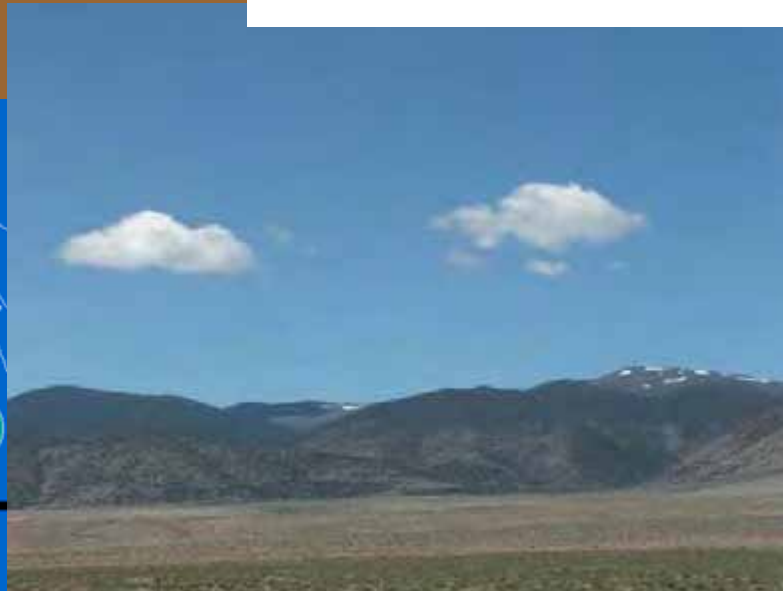
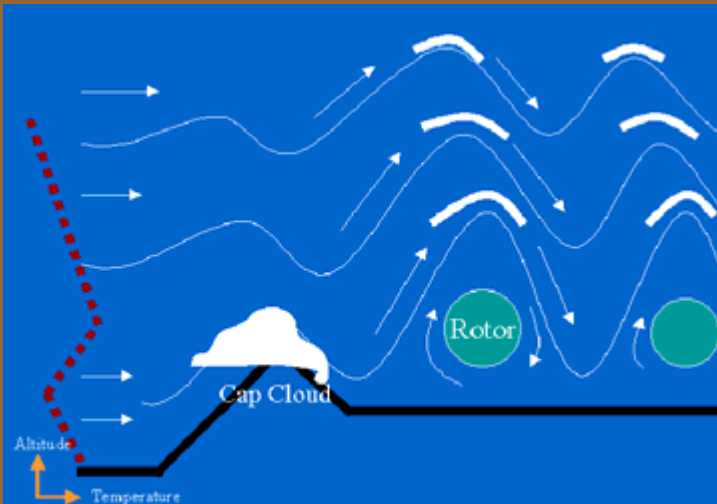
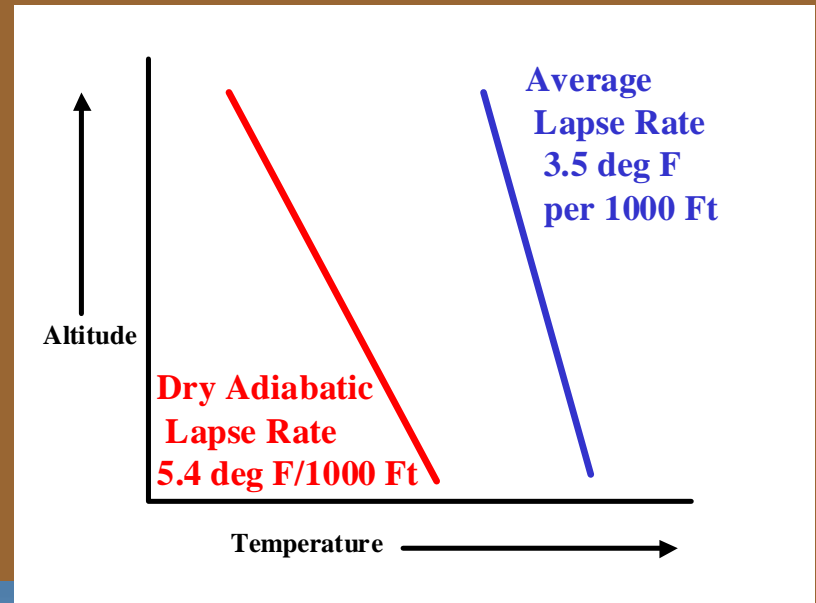
- Storm Prediction Cntr
- Storm Watches
- Thunderstorm Outlook
- Tropical Prediction Cntr
- CSU hurricane forecasts
- MESO Tropical Atlantic Hq

**Aviation**






# 2. Meteorology Points

- Atmospheric Soundings
- Great Basin Applications
  - Convection concepts
- Climate Aspects
- Local Influences



# Sounding Basics

- Small day-to-day changes can make big differences in a soaring day's characteristics
- Spot observation versus need to assess task area air mass, including discontinuity lines
- Altitude noted by Pressure
  - 850 mb  5000 Feet (MSL)
  - 700 mb  10,000 Feet
  - 500 mb  18,000 Feet

NEVADA RAOB SITES



# Sounding Sources

- University of Utah Upper Air Link

<http://www.met.utah.edu/jhorel/html/wx/skewt.html>

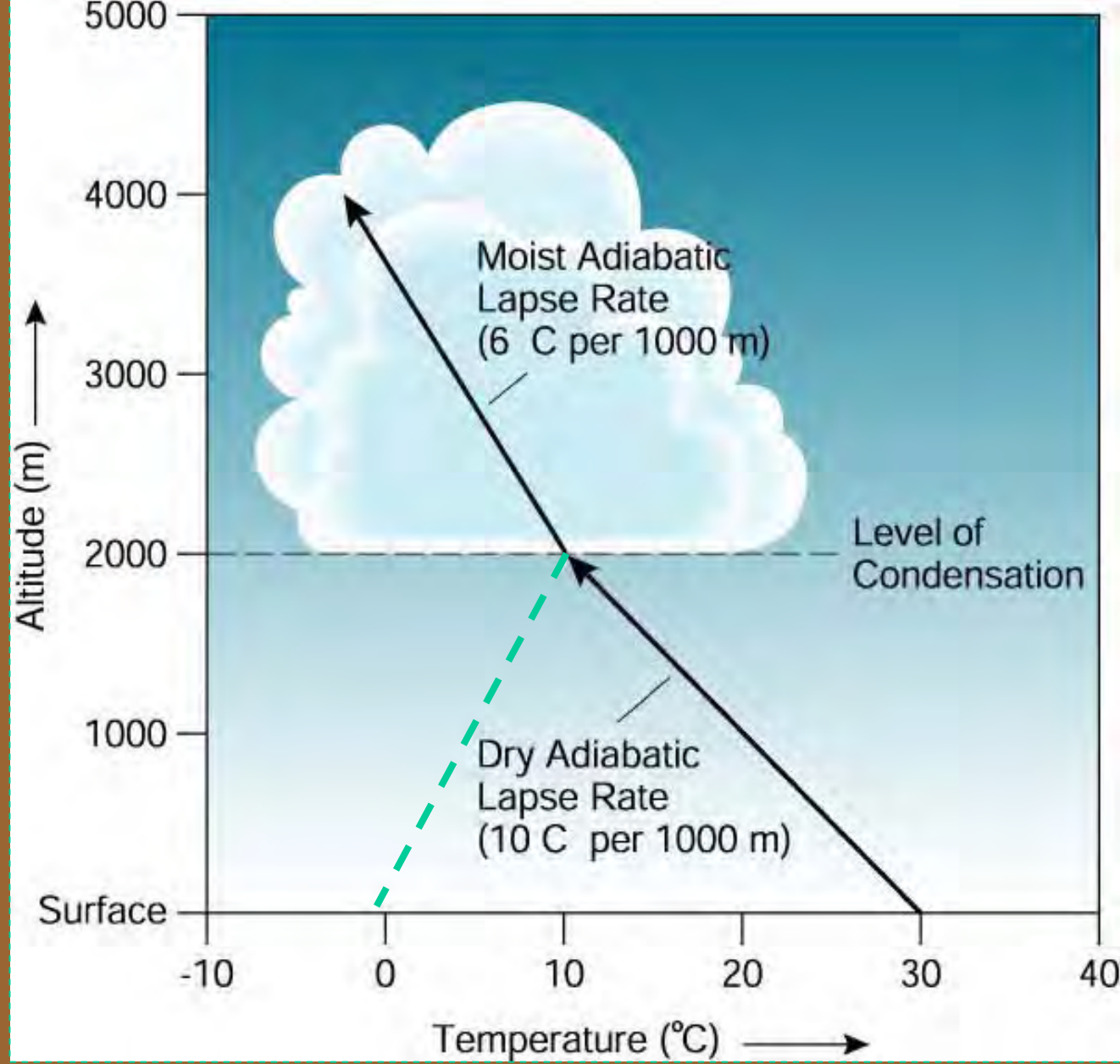
- Unisys Weather Upper Air Link

[http://weather.unisys.com/upper\\_air/skew/index.html](http://weather.unisys.com/upper_air/skew/index.html)



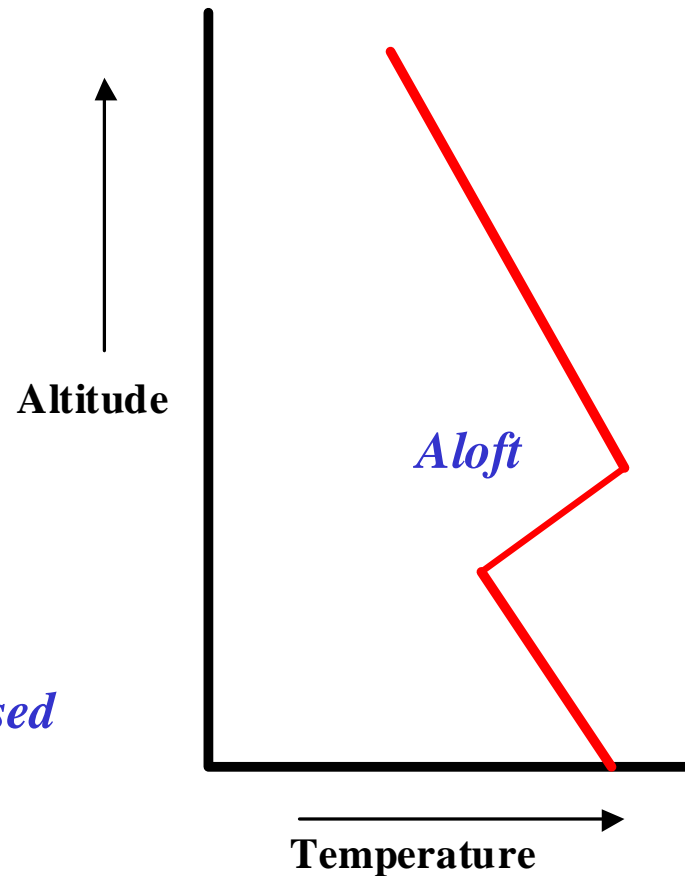
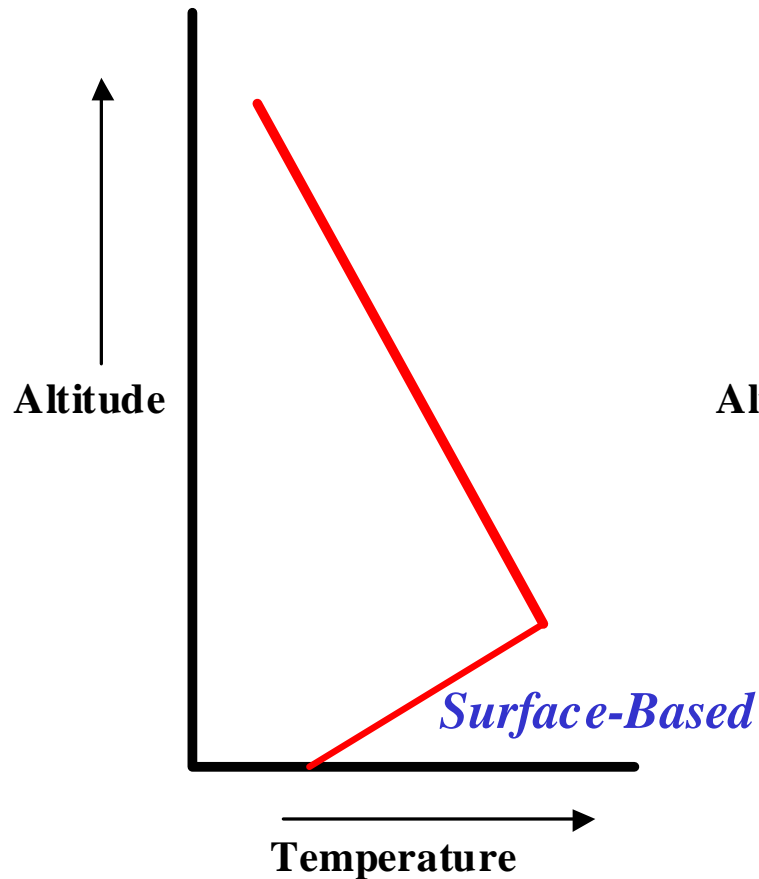
# Lapse Rates

Dry  
and  
Moist  
Adiabatic



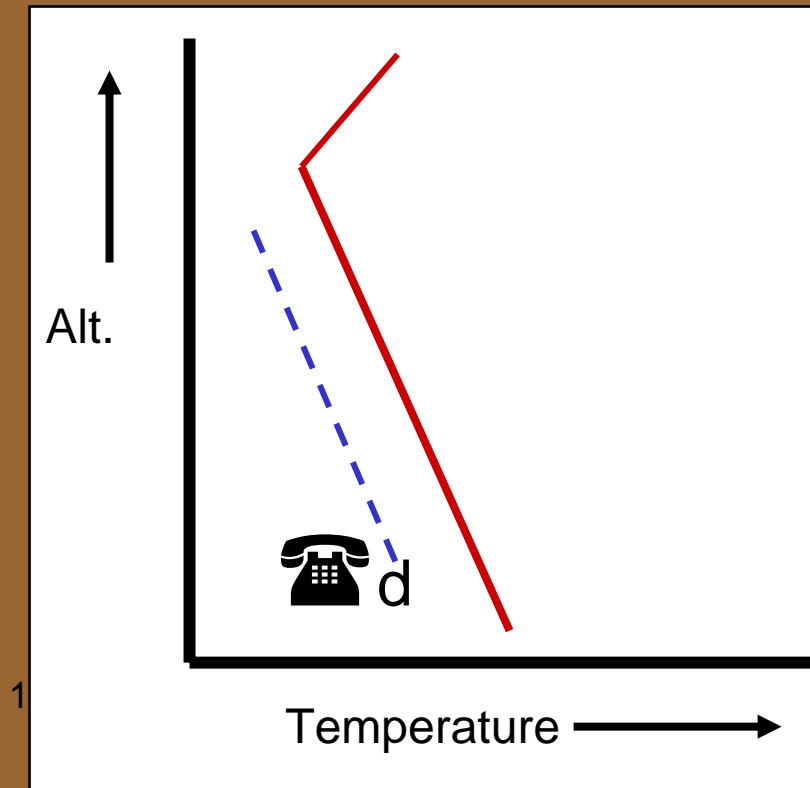
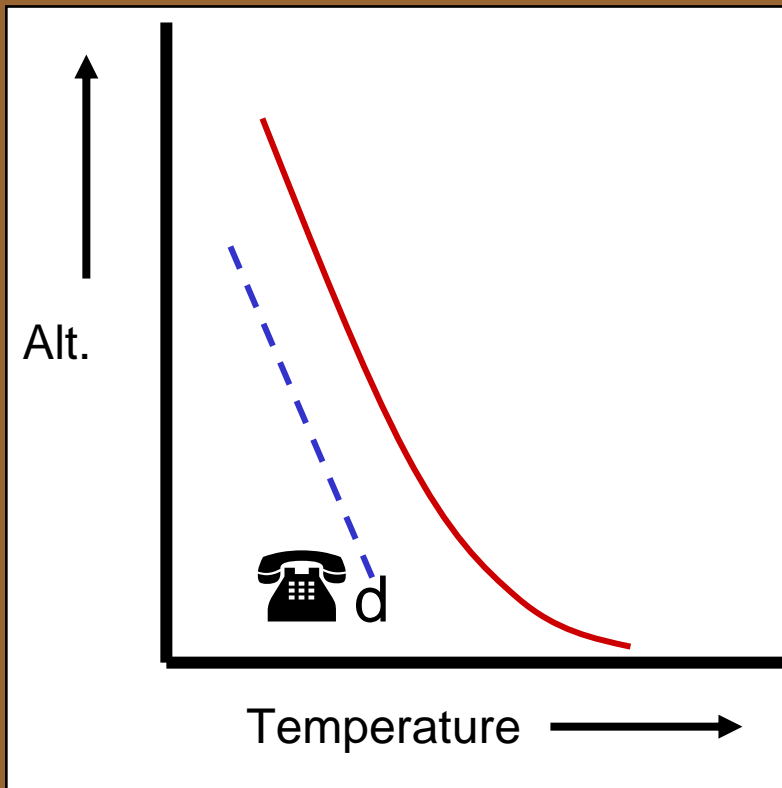
# Temperature Inversions

## *Surface-Based and Aloft*

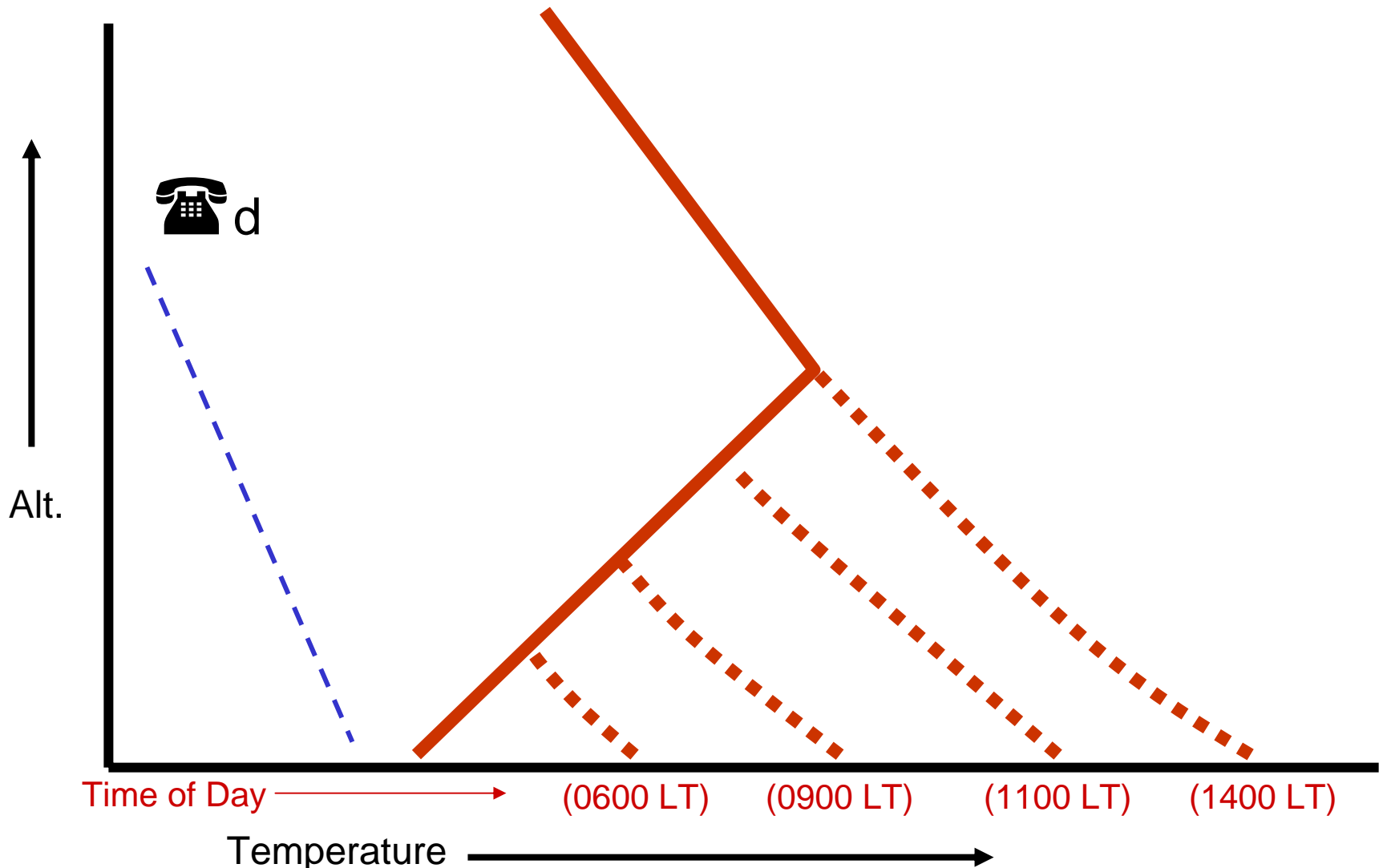


# Profiles

- A mixed atmosphere is near-adiabatic (left)
- Subsidence from high pressure “caps” convection but high enough to facilitate soaring over terrain (right)

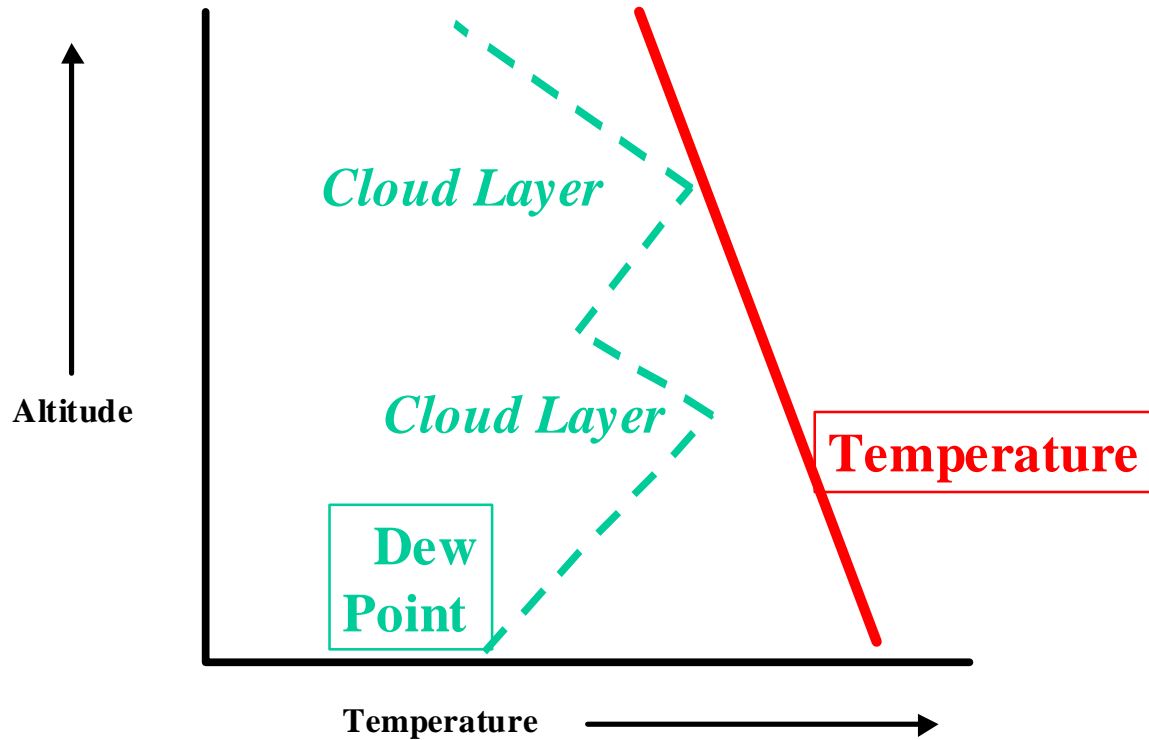


# Surface-Based Inversion Erosion with Time



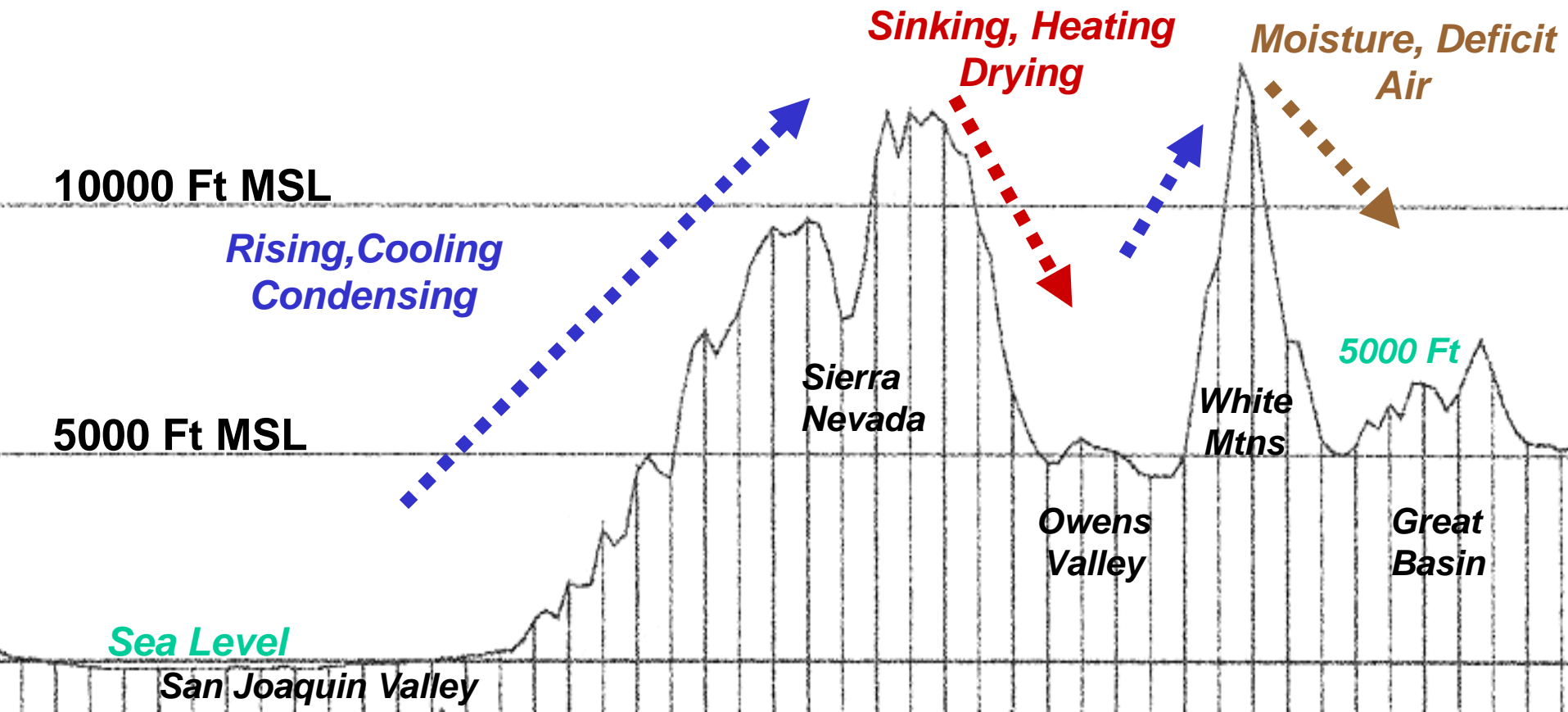
# Cloud Base / Moisture Layers

- T / DP Closure  
-Possible Cloud Layers
- Moist Adiabatic Lapse Rate





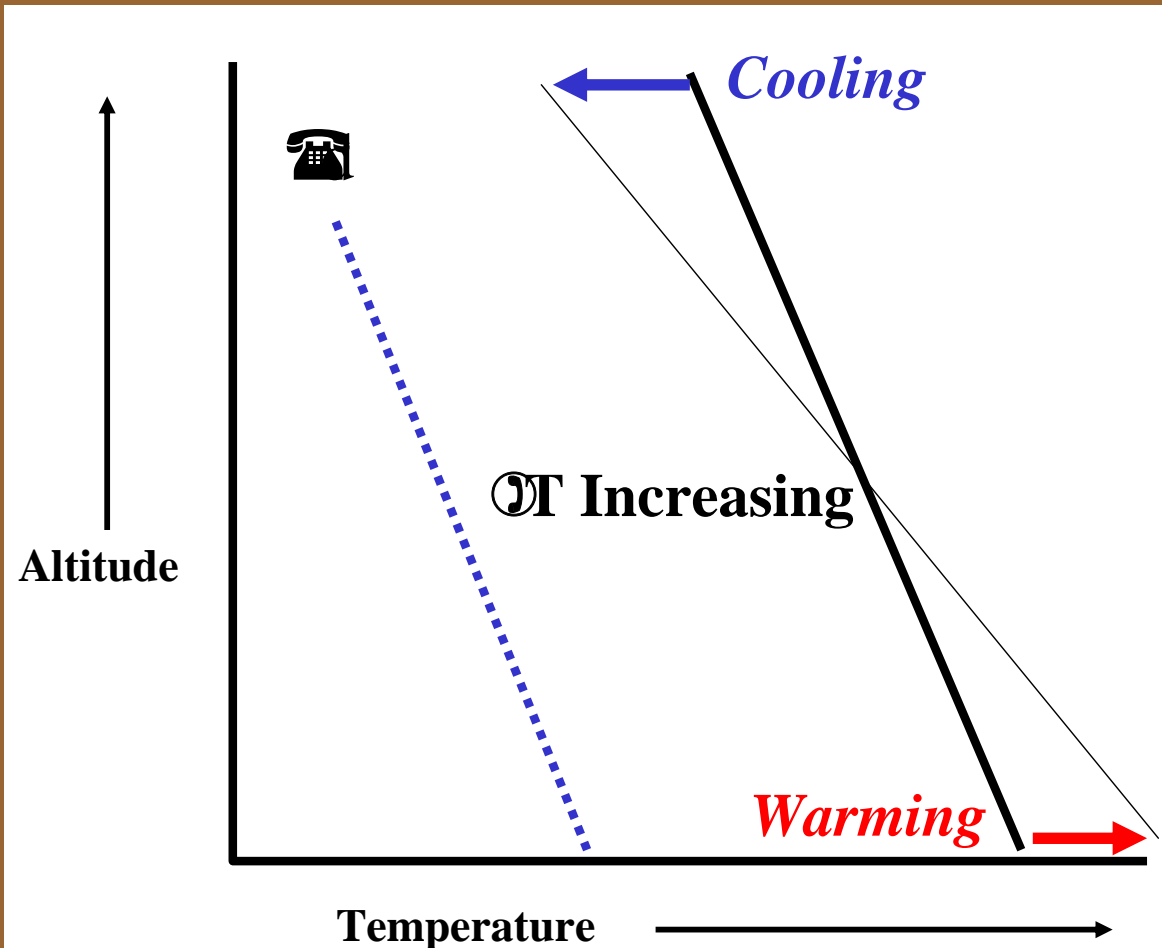
# The Drying Process



# De-Stabilizing Process

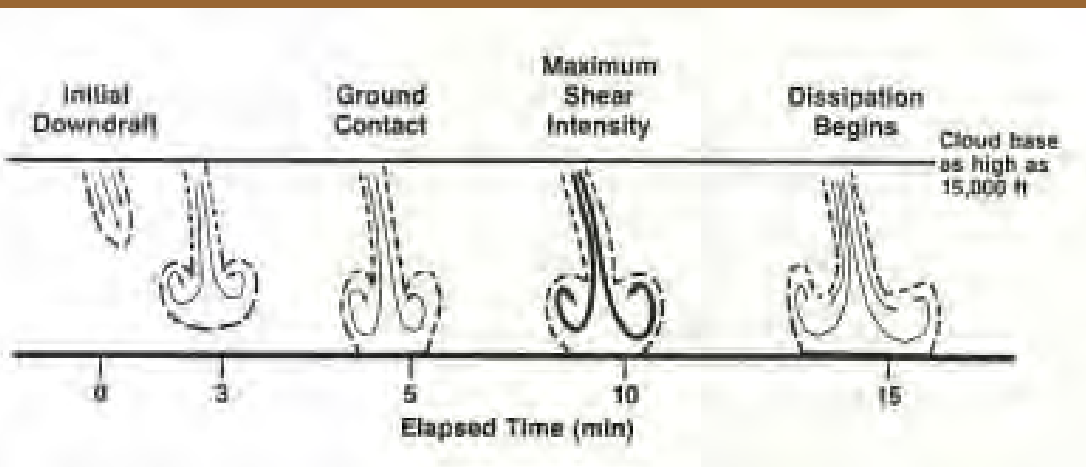
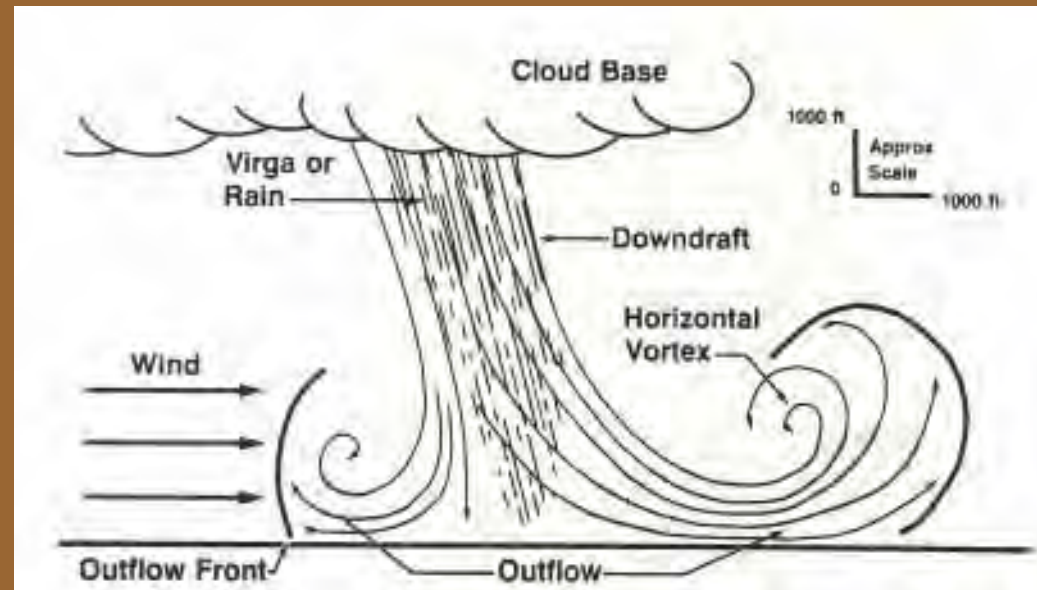
Colder Air Advection above, and/or  
Warm Air Advection below will de-stabilize

- Delta-T increase!
- Moisture presence also de-stabilizes



# Basin Thunderstorm / Microbursts

- Develop Adjacent cells
- Classic short duration
- 60Kt+ Sink Rates
- Regardless of cell size
- Wind shifts
- Degrade ceiling and visibility

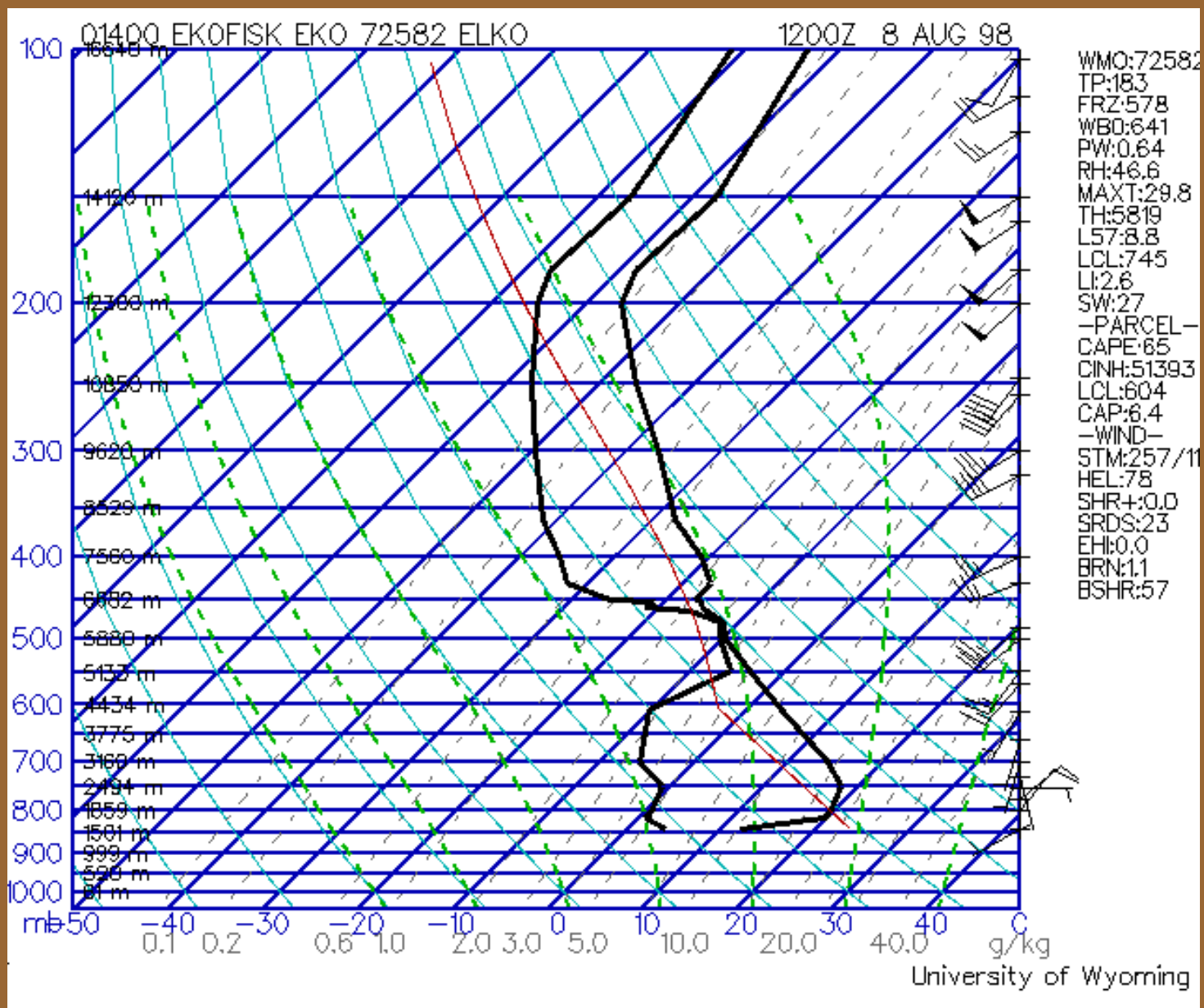


# *Mojave Desert Downburst*

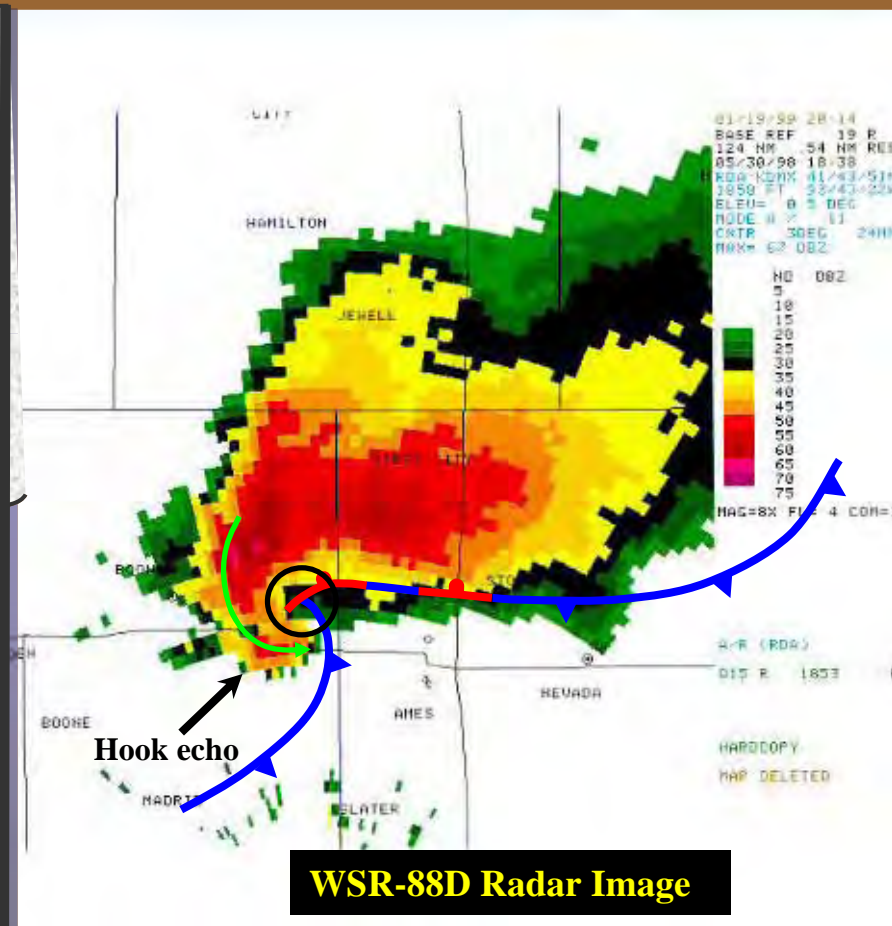
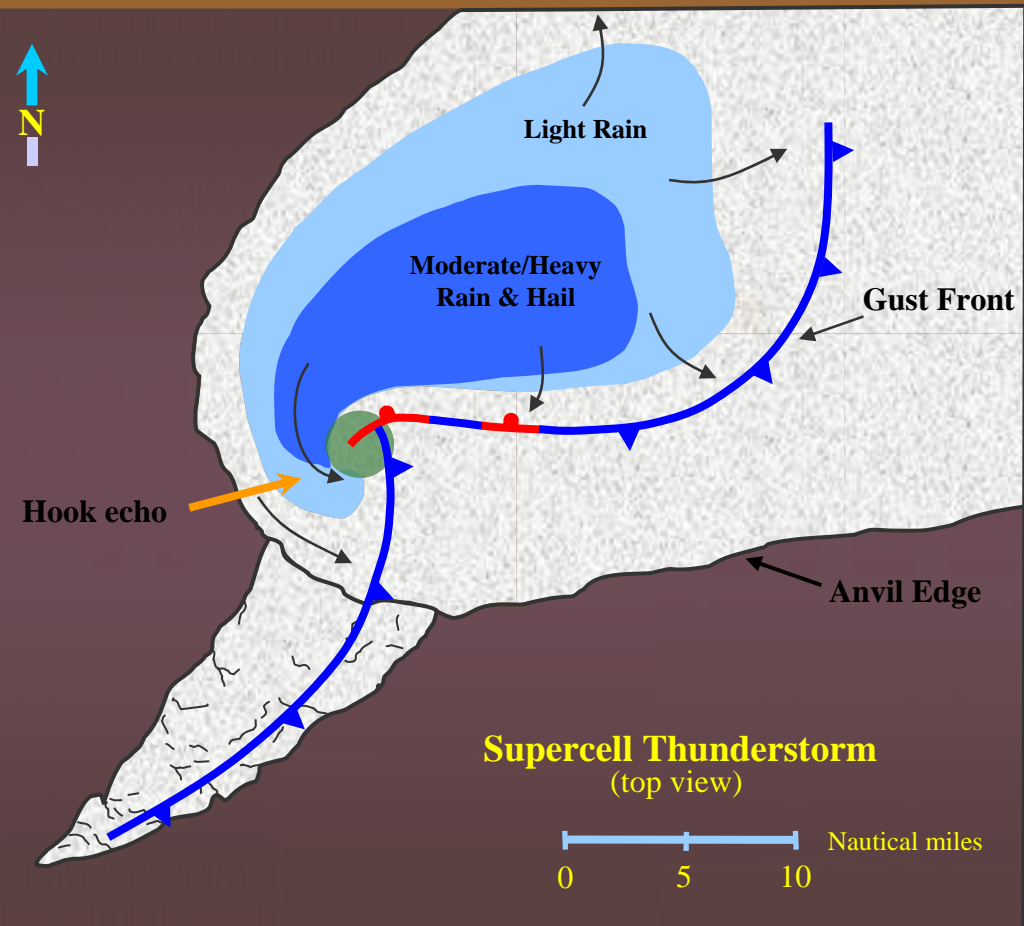


*Courtesy of Caracole Soaring, California City, CA*

# Microburst Sounding



# Classic Supercell Thunderstorm



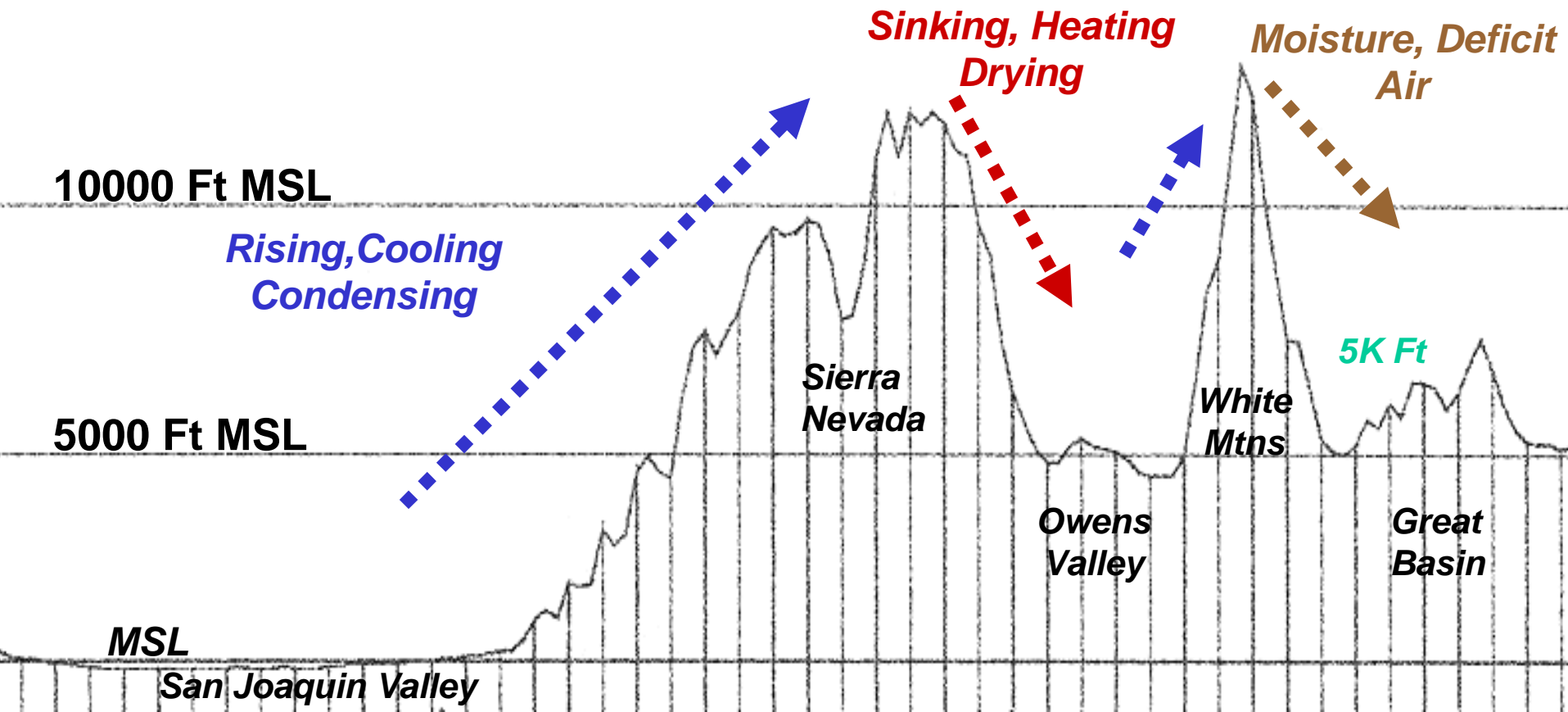
# Climate and Other Influences

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- Climate and Terrain Considerations
- Modifying Influences and Contributions
- Thunderstorm Indices

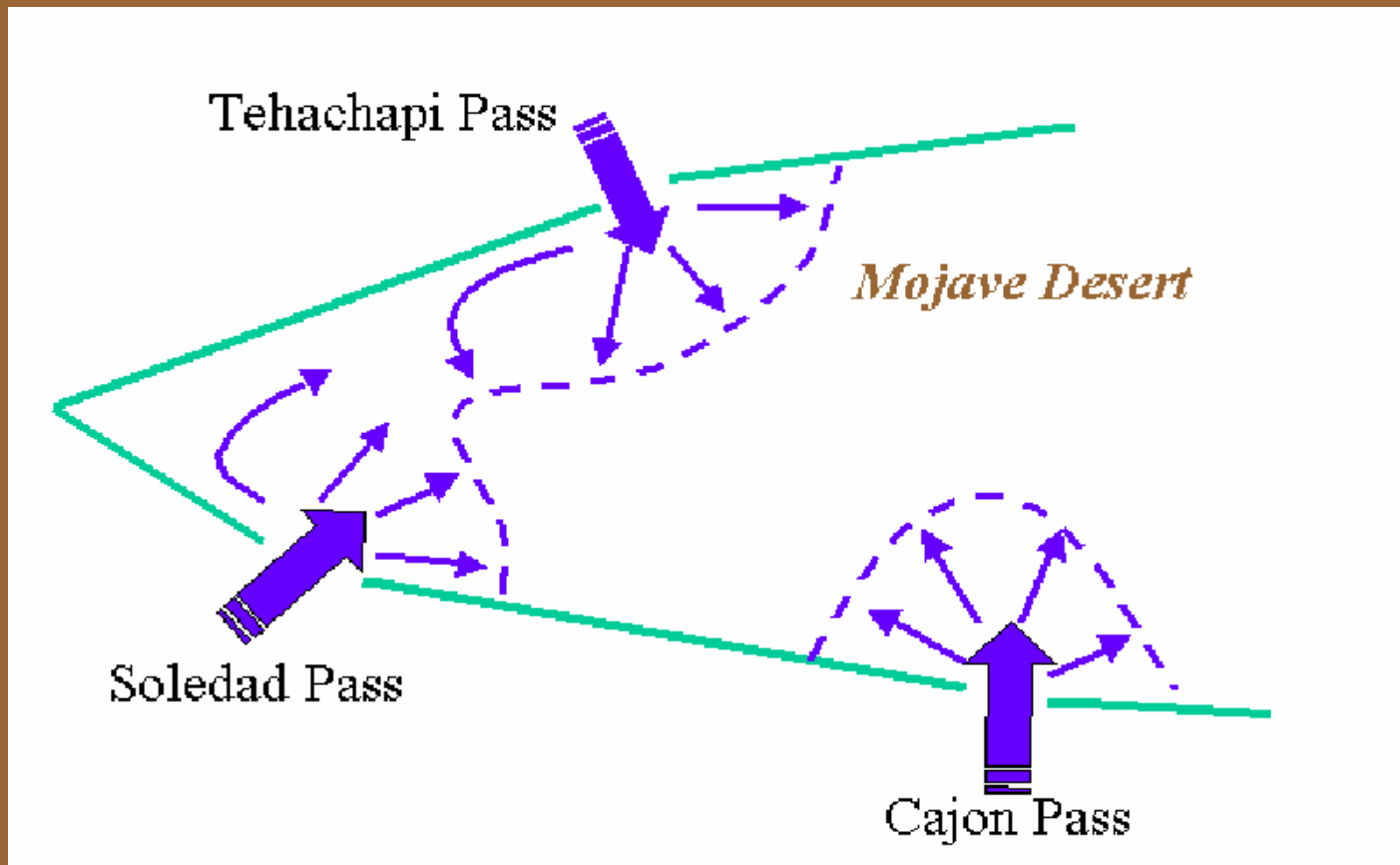


# The Drying Process

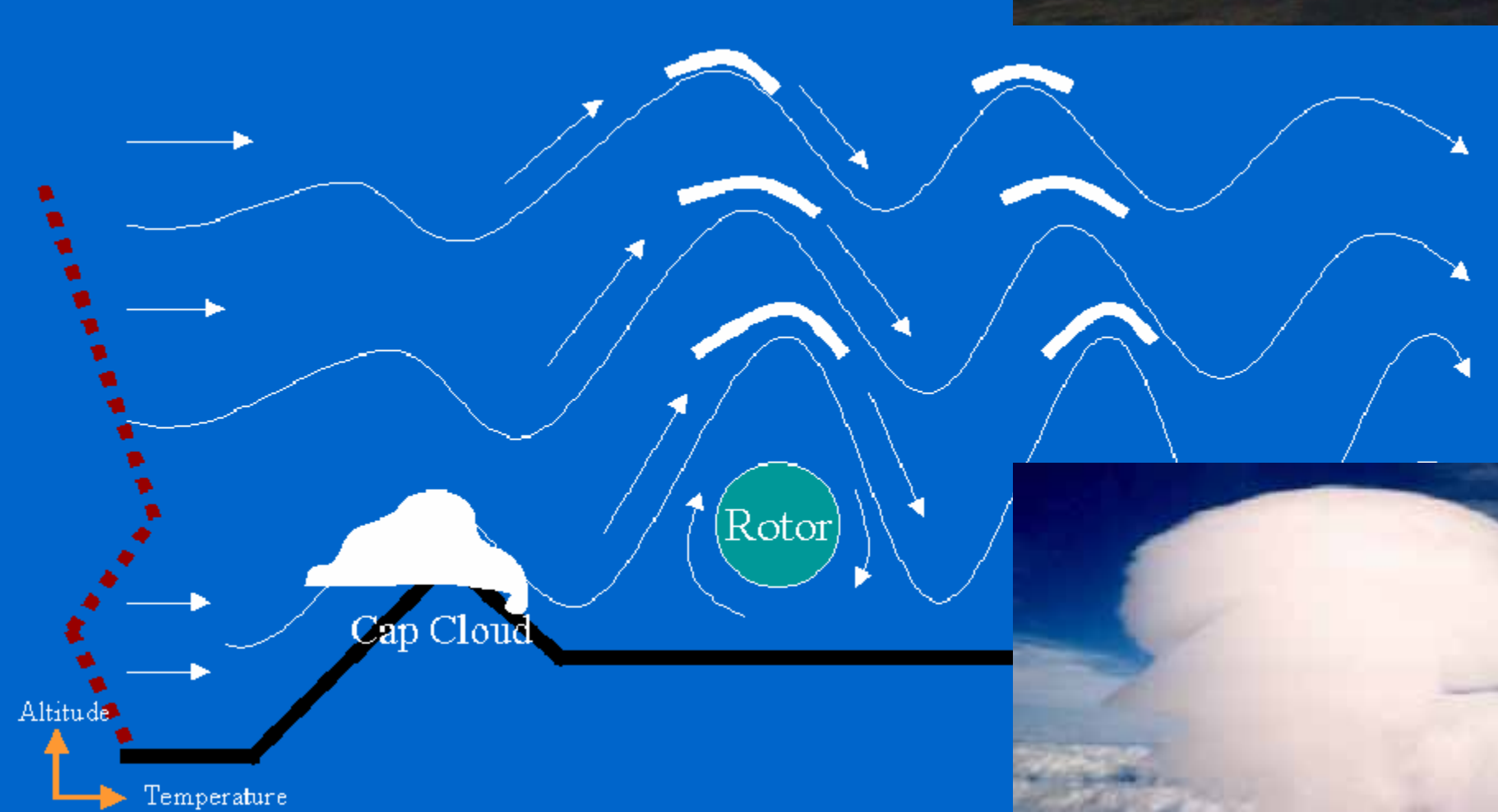




# Mojave Desert Shearlines

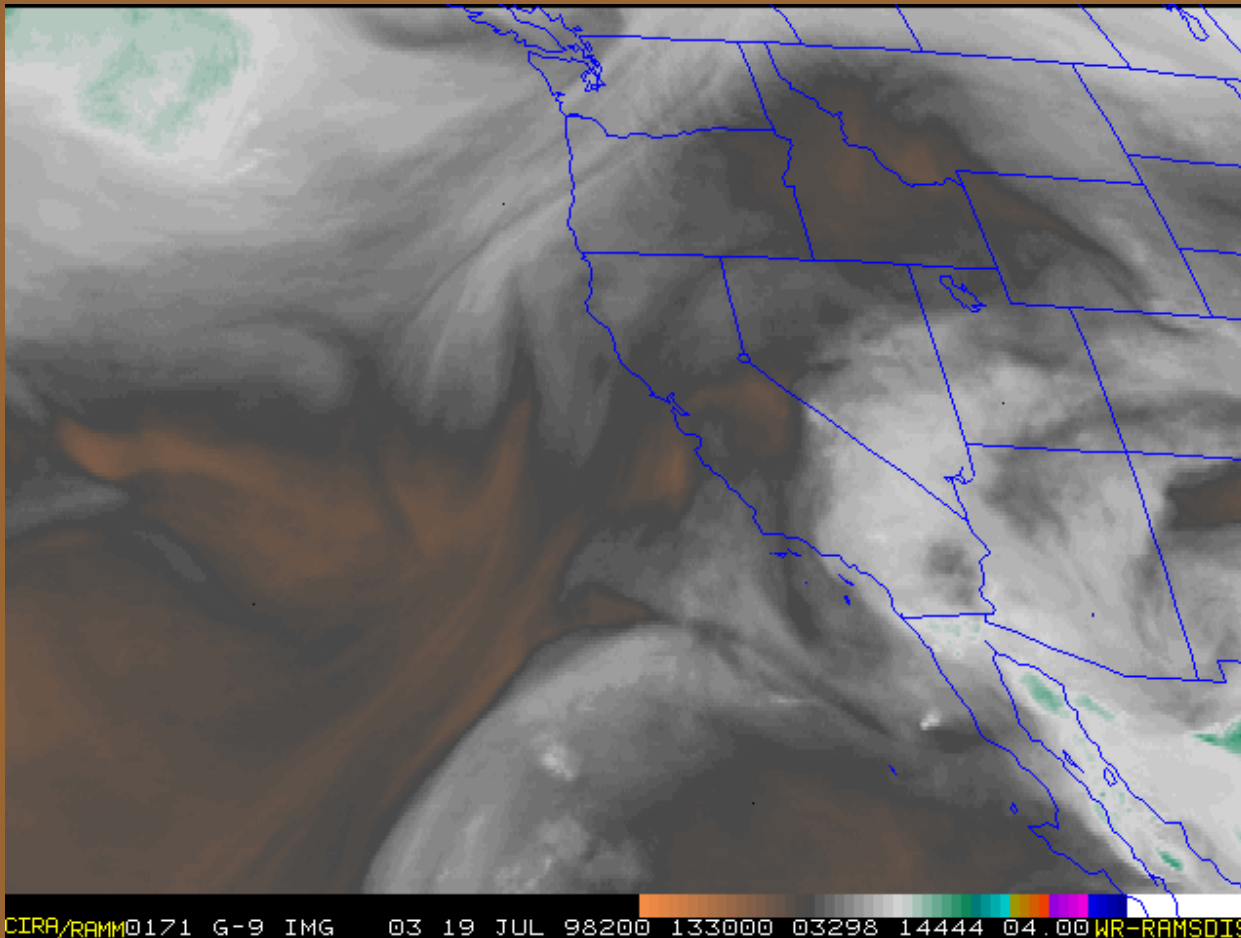


# Mountain Wave



# Water Vapor Satellite Imagery

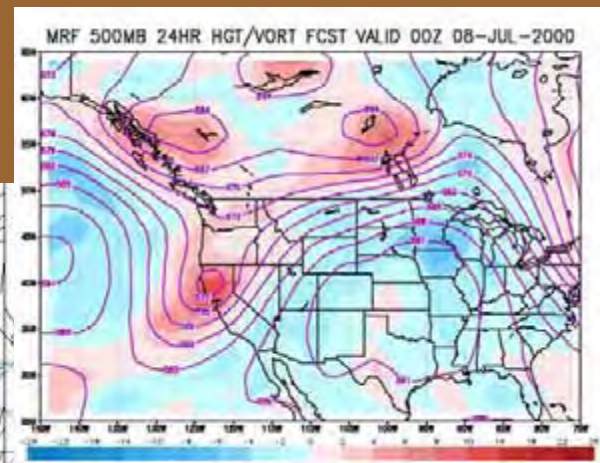
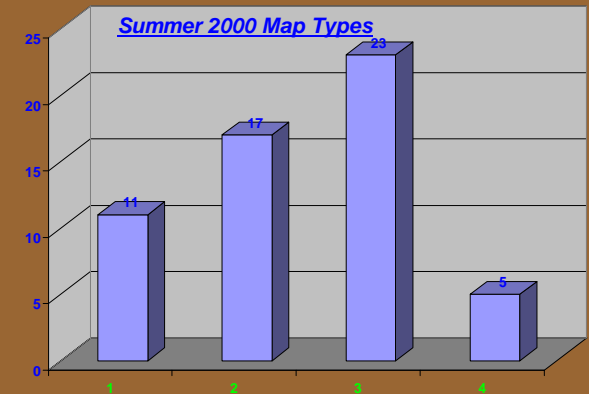
- Moist and dry air boundaries
- Active convection often along interface
- Determine Raob representativeness of task area?



# 3. Synoptic-Scale Weather Patterns

## *Weather Types Favorable to Long Distance Soaring*

- Type #1: Four-Corner High
- Type #2: Strong Ridge
- Type #3: Low Center, Trough, Short-wave Proximity
- Type #4: Building Ridge Aloft



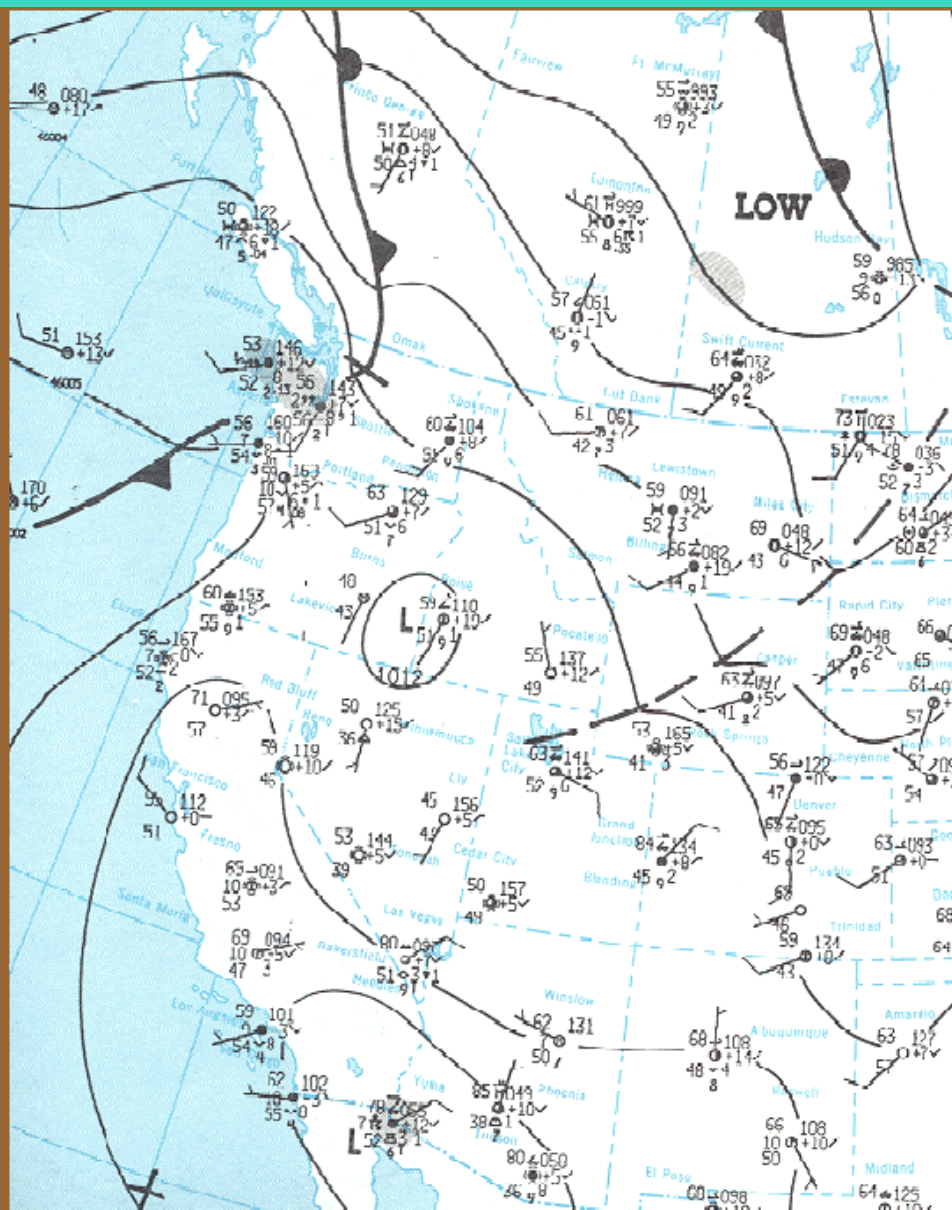
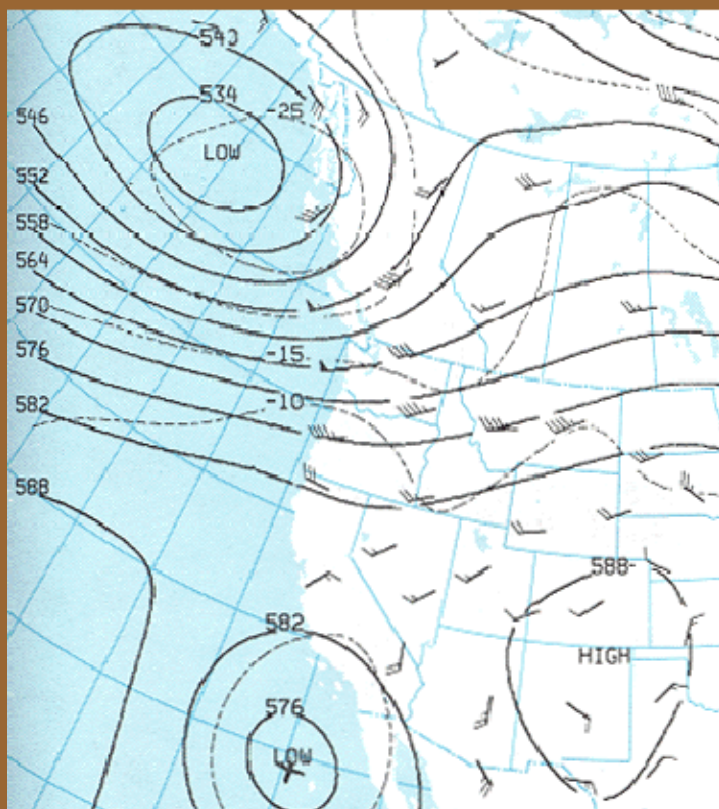
# Type #1: The Four-Corner High

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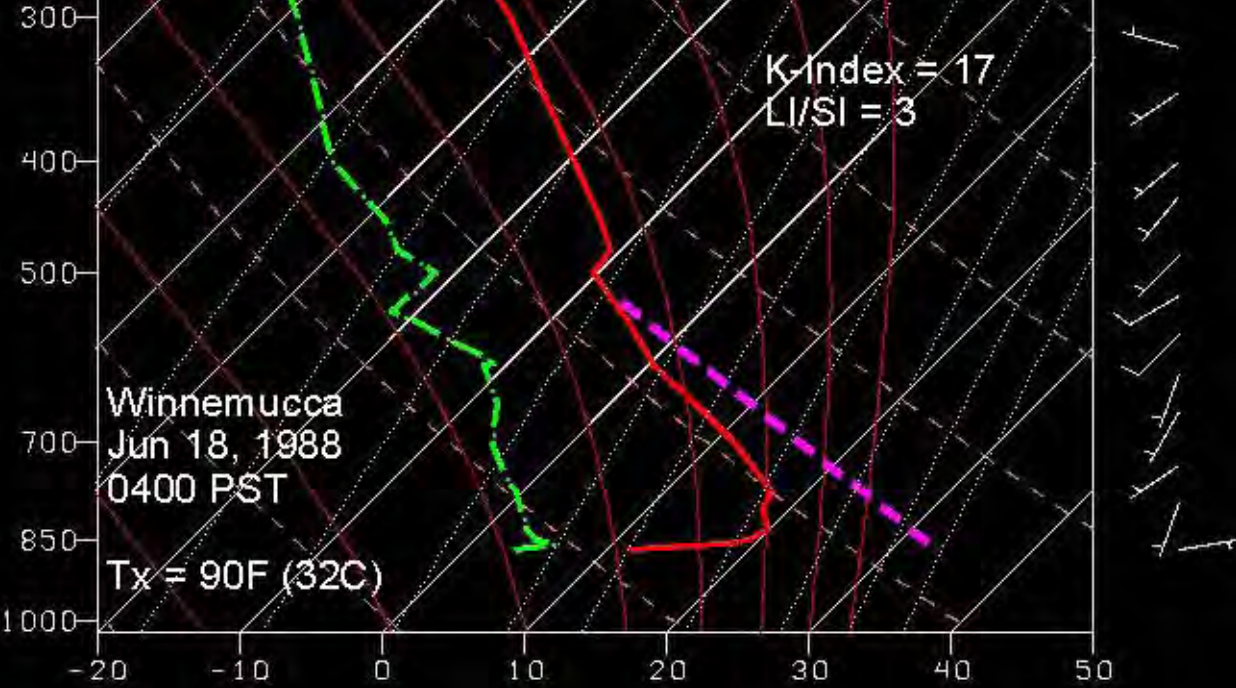
- High pressure centered aloft near the Four Corner area of the Southwest U.S.
- Most recognized, "Classic" long flight pattern
- Good low level heating de-stabilizes the air mass
  - Light surface wind
  - Lower layer warm air advection
- Monsoon moisture tap ... therefore usually not a long-lived pattern
- Good soaring ... but days get truncated with afternoon TSTMs... often widespread

# Type #1: 6/18/88

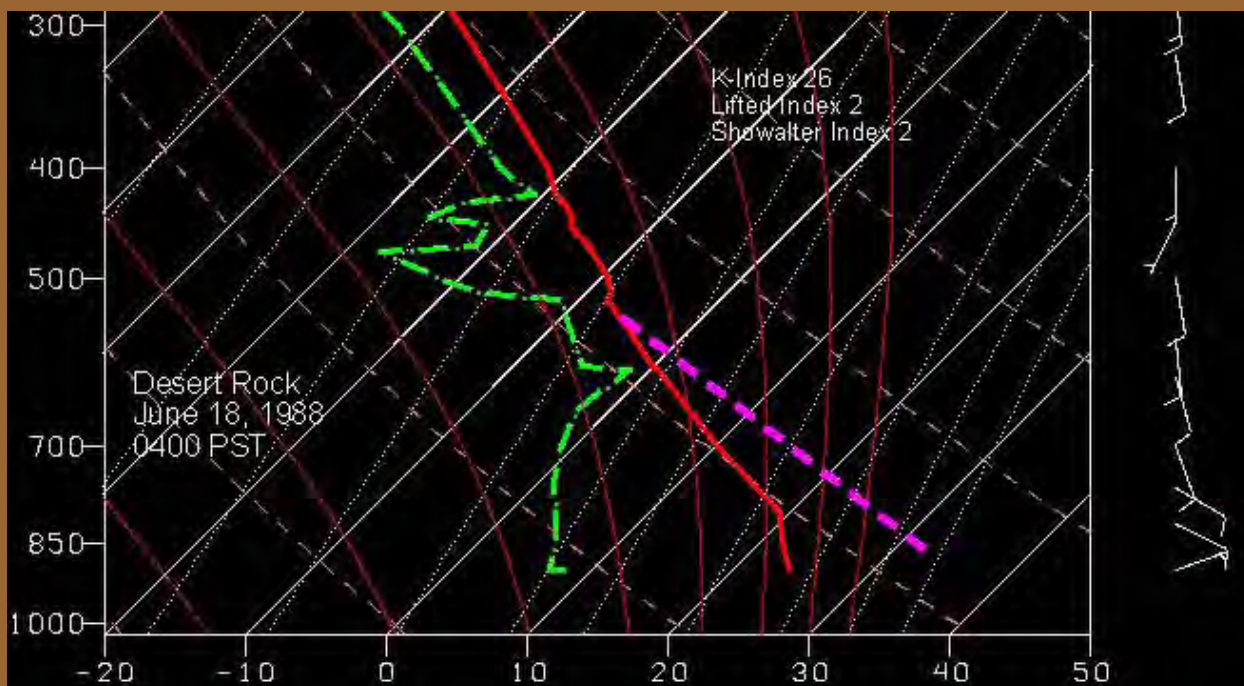
ASI to Keeler and return



# 6/18/88 Raobs



- WMC 94/50
- RNO 90/58
- TPH 83/52
- LAS 98/78



# Type #2: Strong Ridge

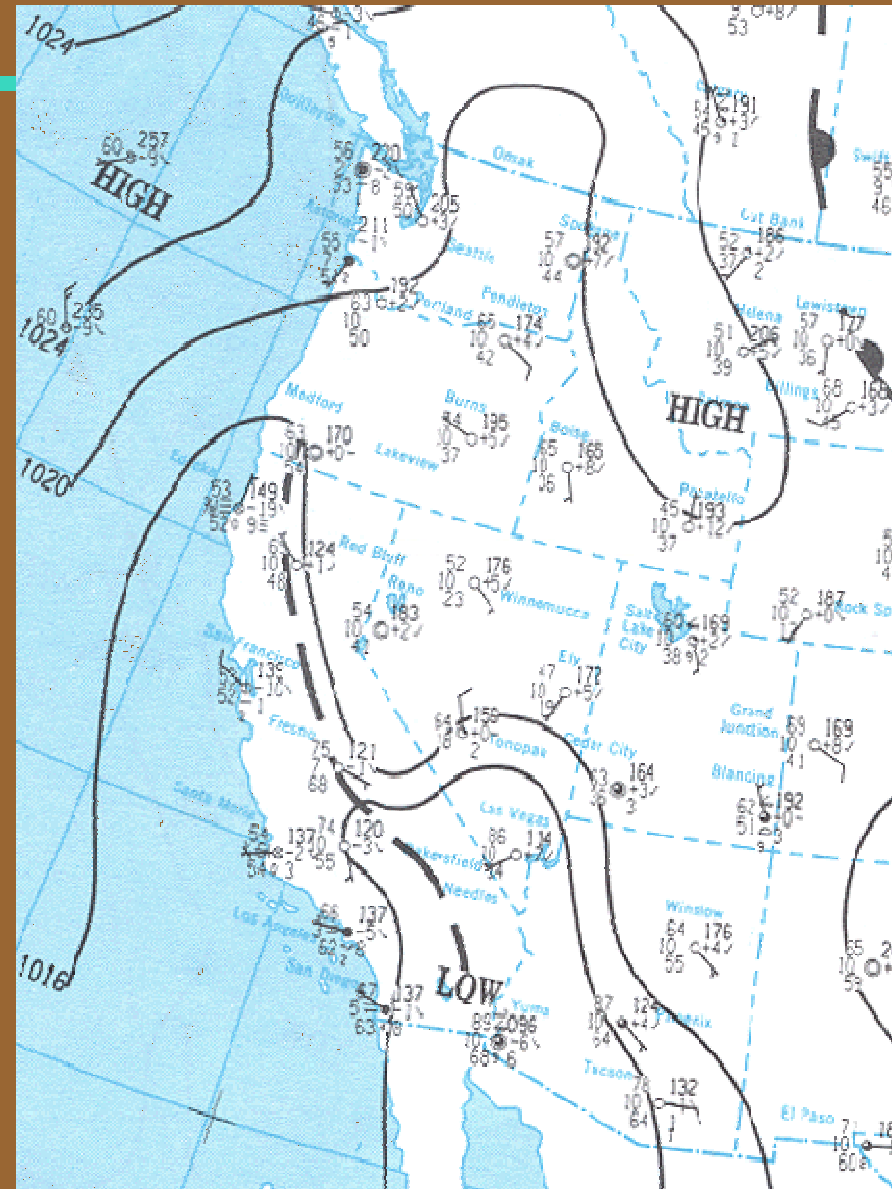
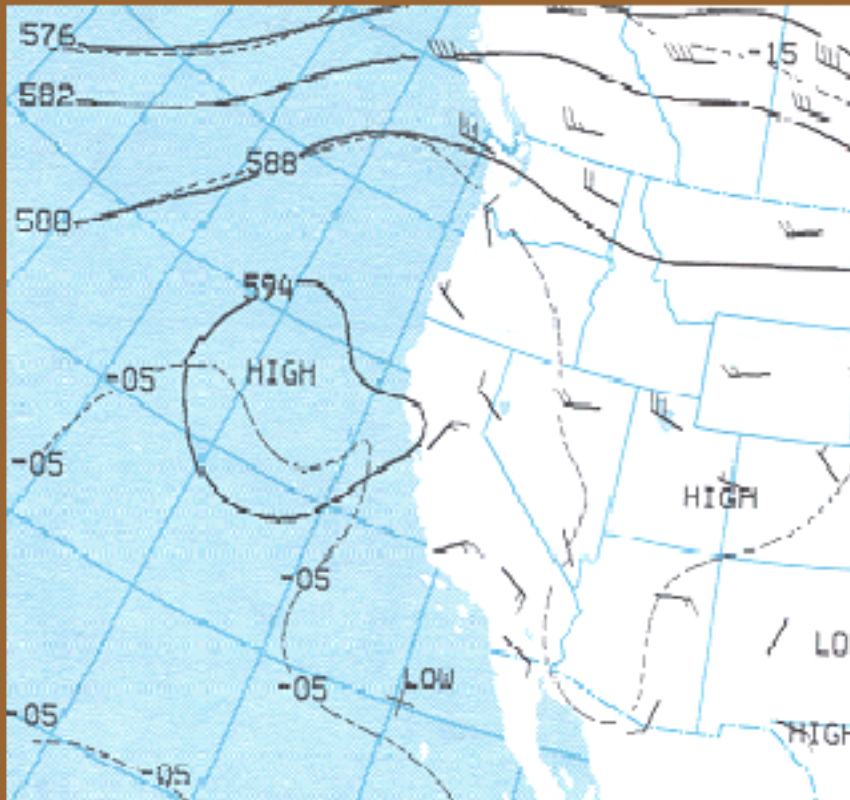
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- Light wind
- Low level heating
- Thermal trough well to the west of task area
- Impulse aloft over ridge axis; or,
- Ridge axis aloft east of the task area



# Type #2: 8/9/96

Long-lived, extraordinary pattern  
Numerous 1000Km flights  
Over a 4-day period



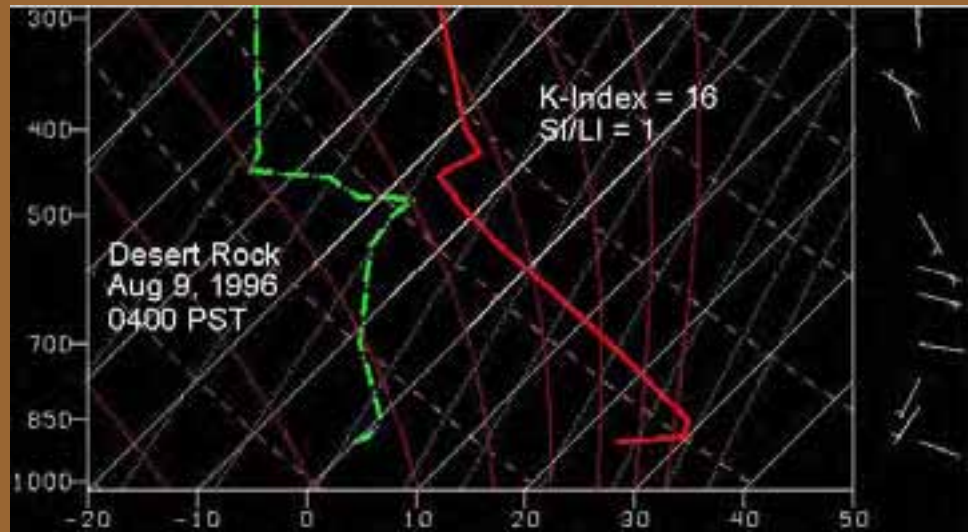
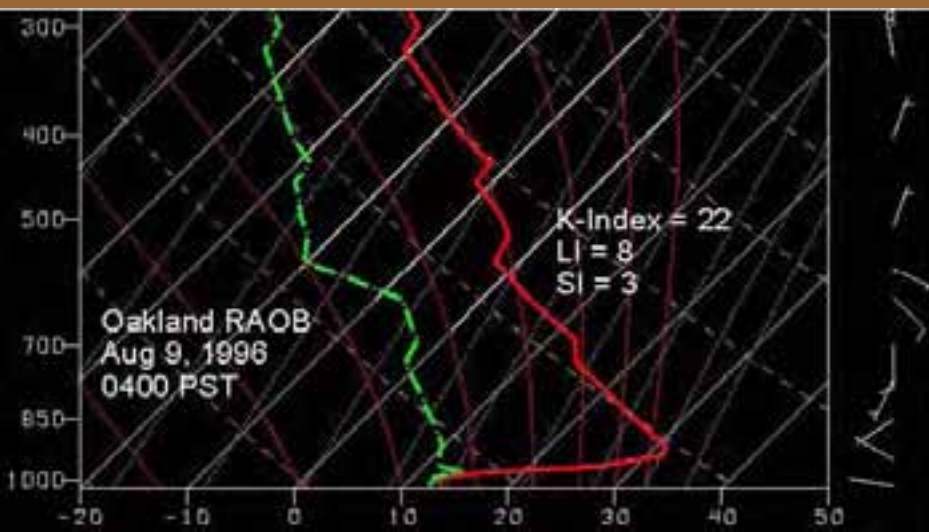
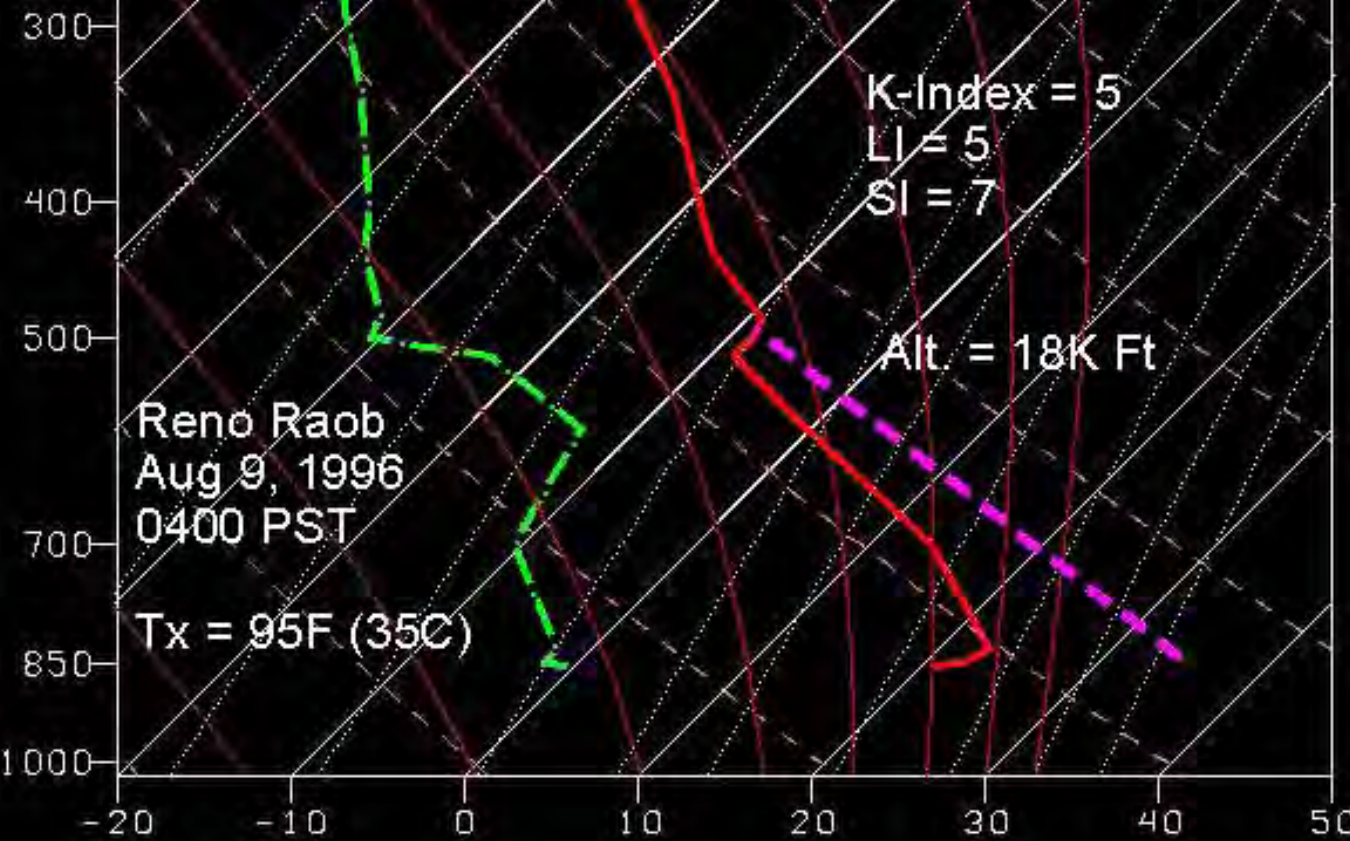
8/9/96

WMC 98/48

RNO 95/53

TPH 95/61

LAS 99/80



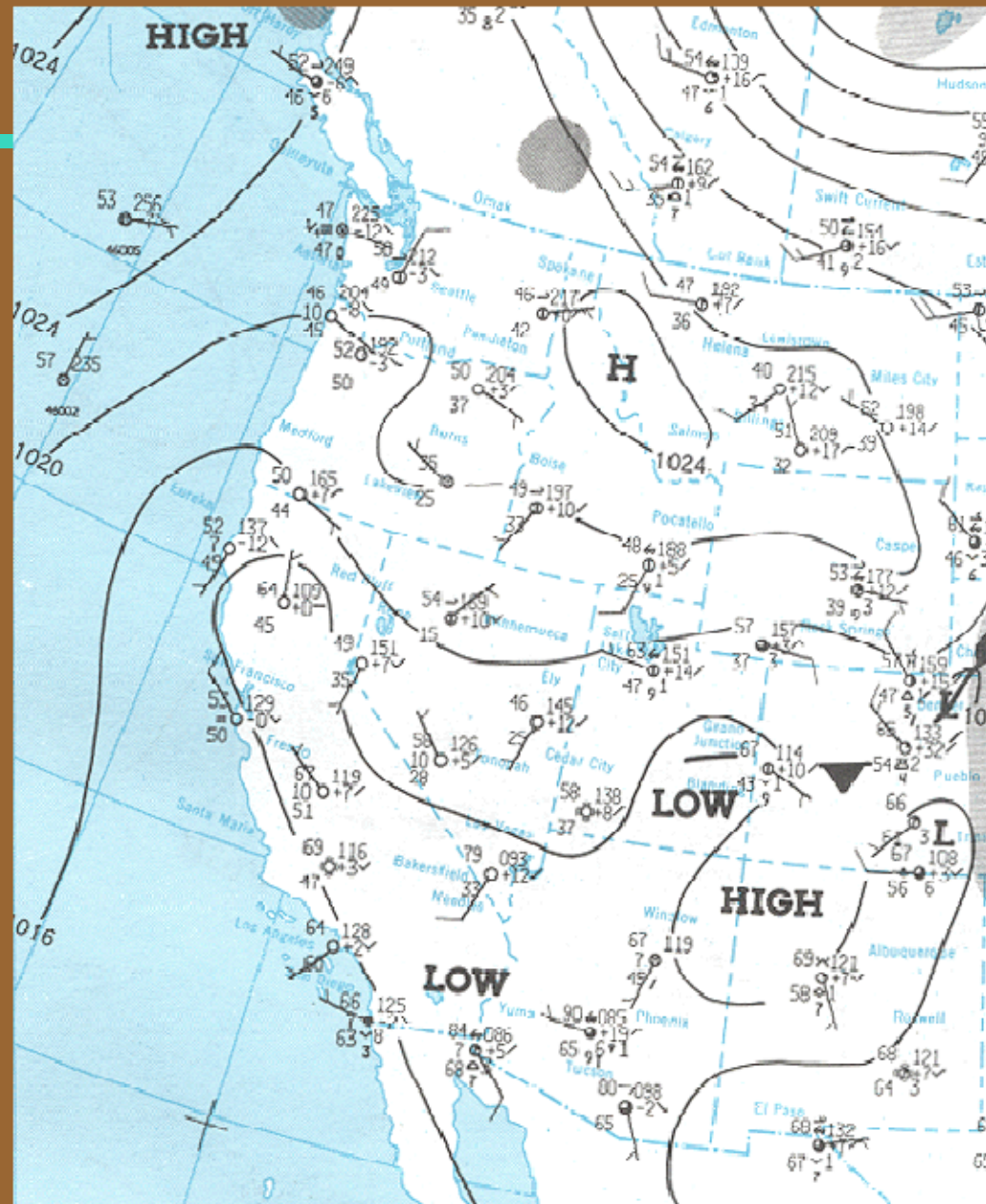
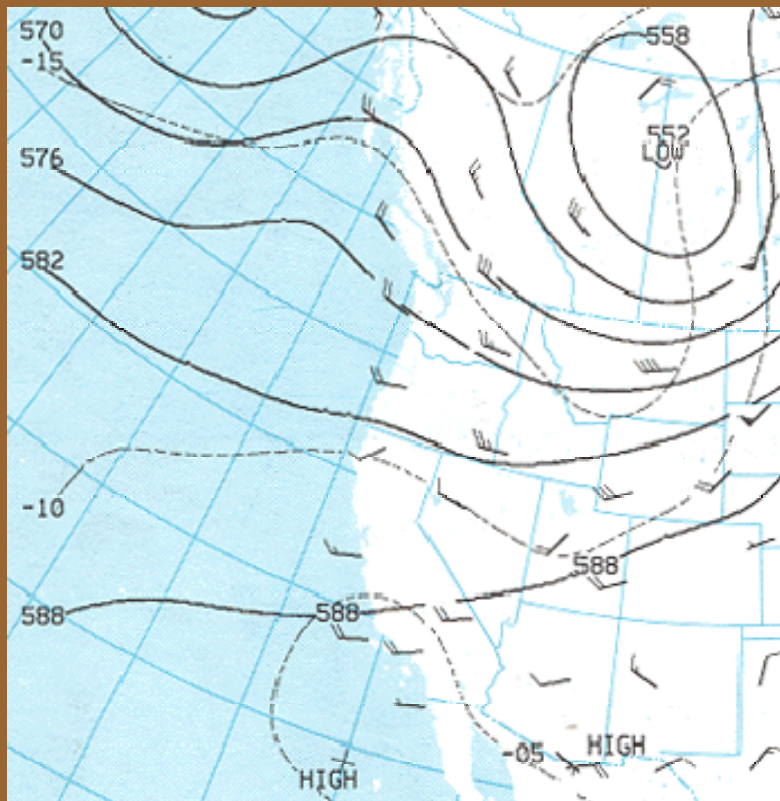
# Type #3: Low Center, Trough, or Short Wave Proximity

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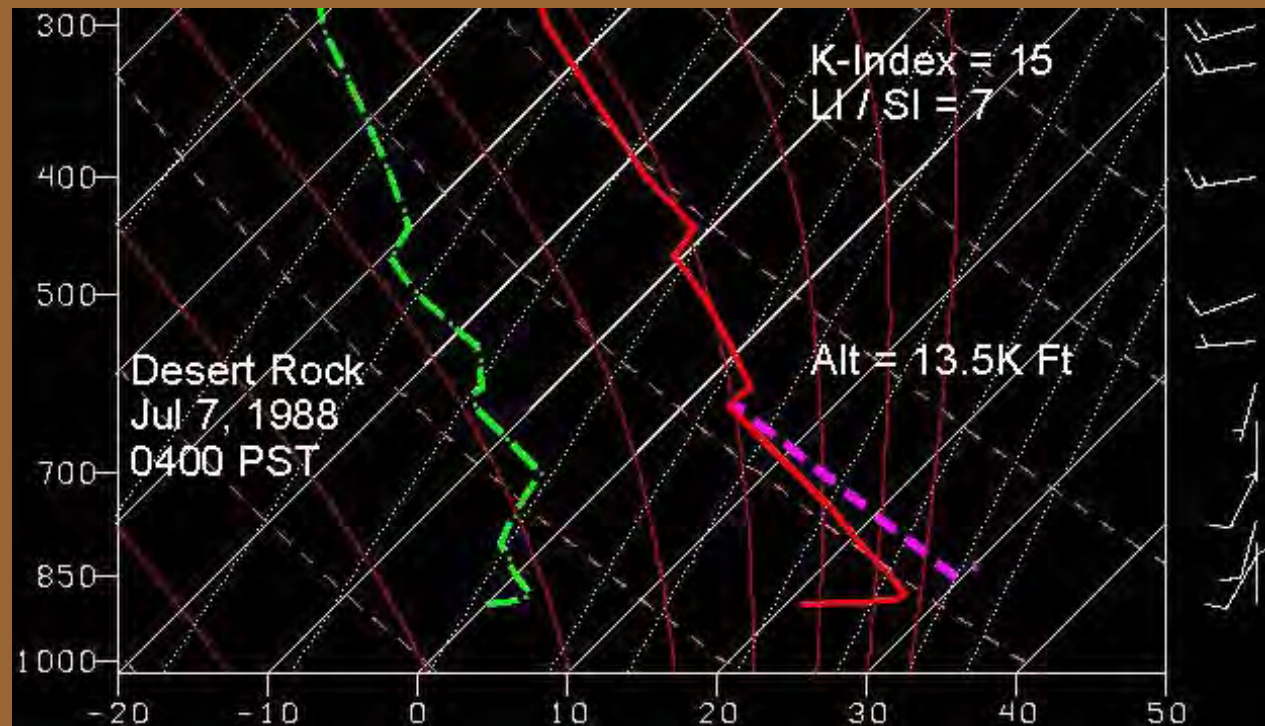
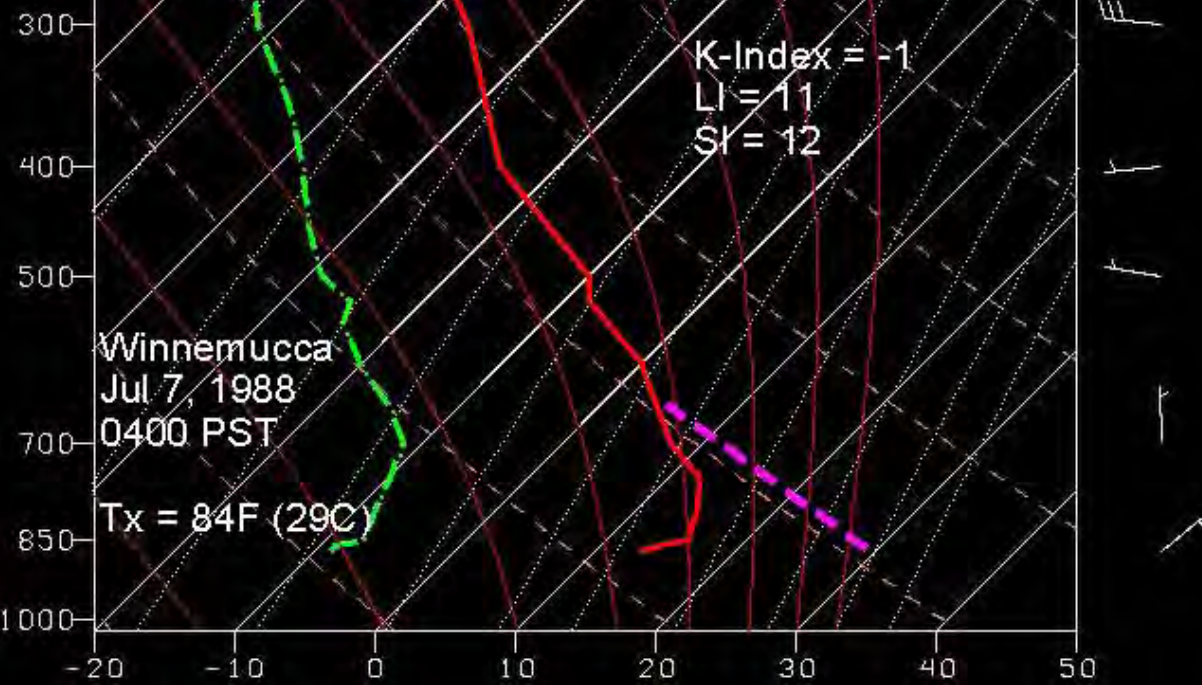
- Ridge axis to the east; Trough axis proximity
- De-stabilizing by cold air advection aloft
- But light wind and/or split in the jet aloft
- Thermal trough closer to NV; but...
- Low level Zephyr washout delayed
- Still able to heat lower levels
- Prevalent pattern for long distance soaring!

# Type #3: 7/7/88

Flight of 350 miles



# 7/7/88 Raobs



WMC 84/54

RNO 84/49

TPH 90/56

LAS 103/77

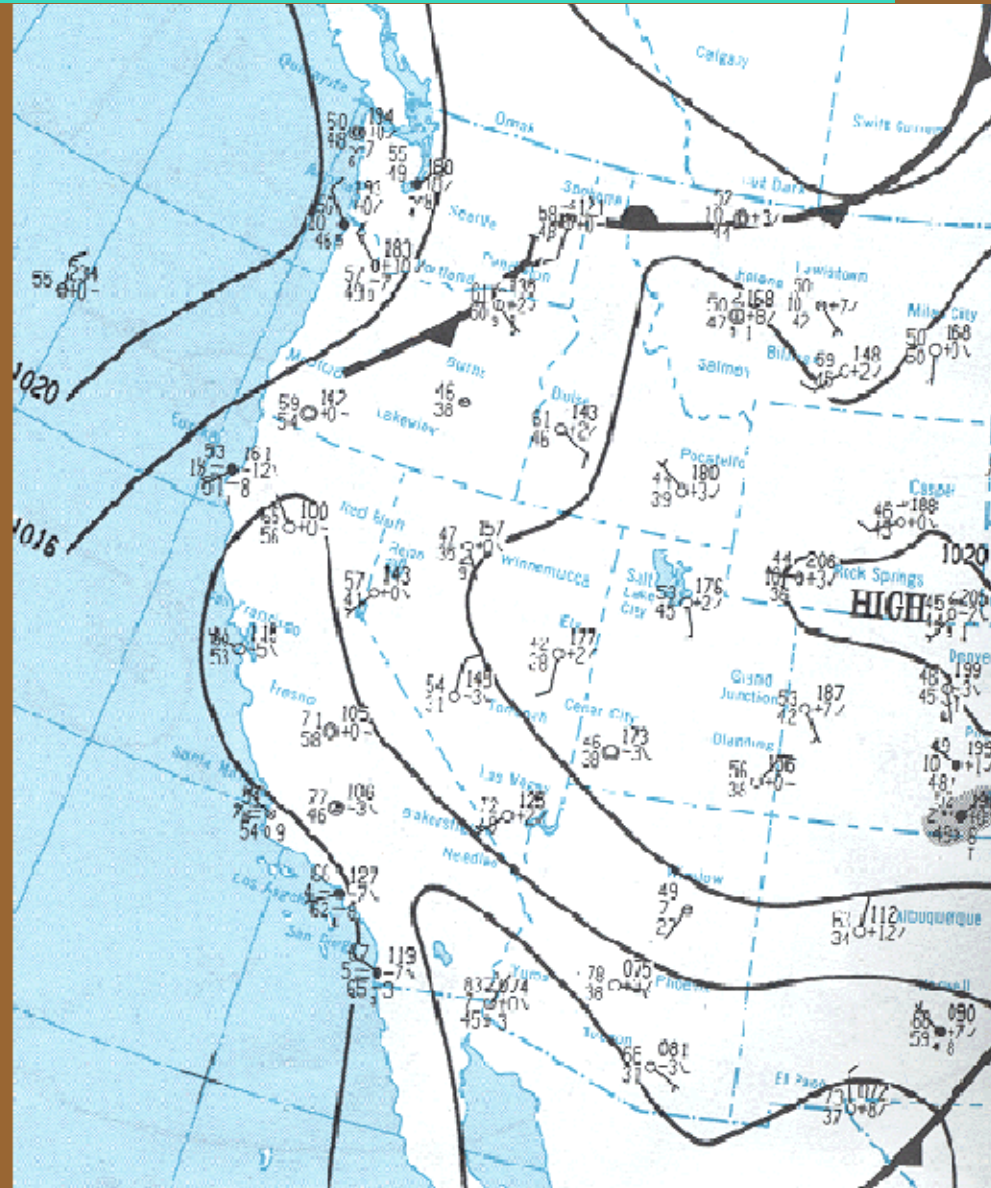
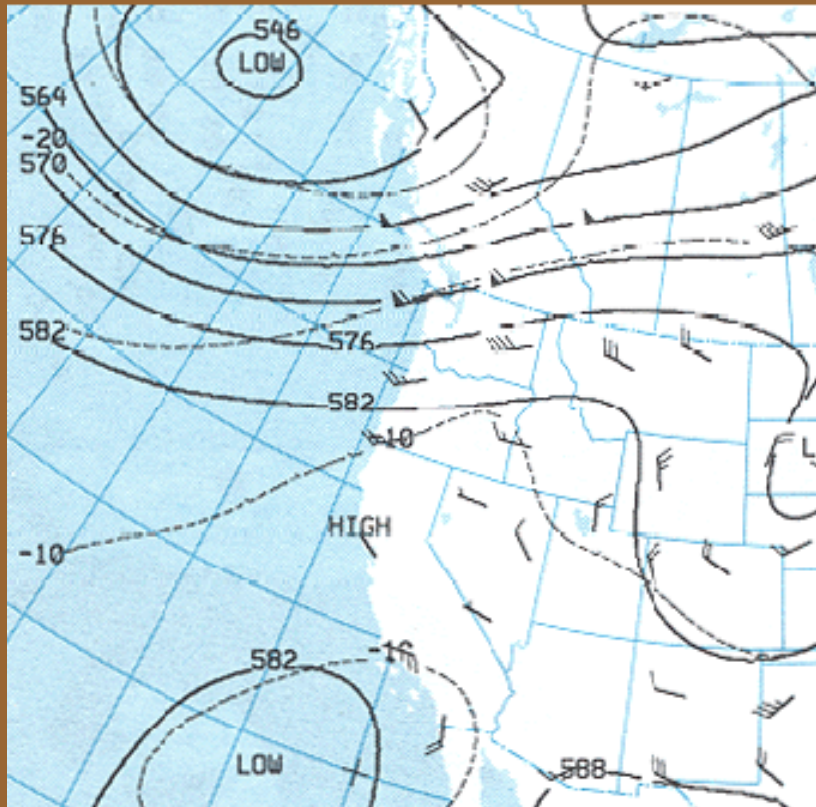
# Type #3(a): Proximity of Low Pressure Center

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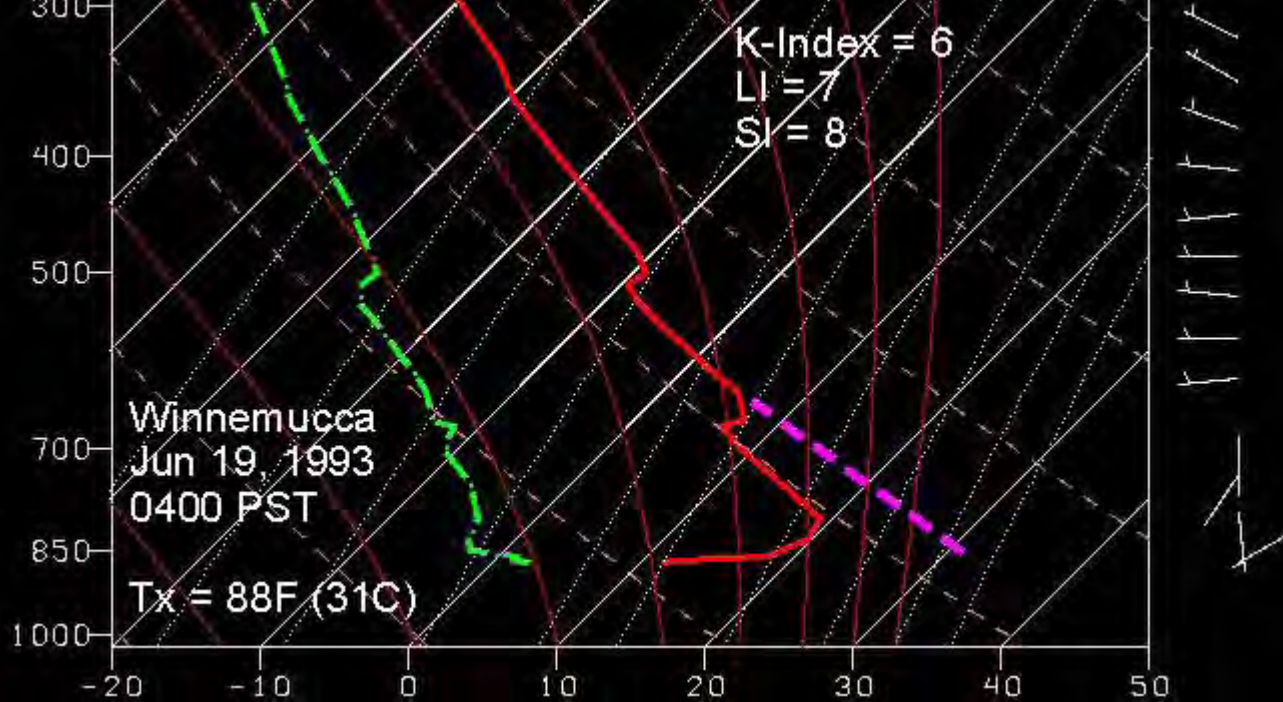
- ☒ Low off Southern California coast provides cooler air aloft upstream to destabilize
- ☒ Elevated heat source influence contributions

# Type #3(a): 6/19/93

1000Km flights from Truckee  
And Minden area



# 6/19/93 Raobs

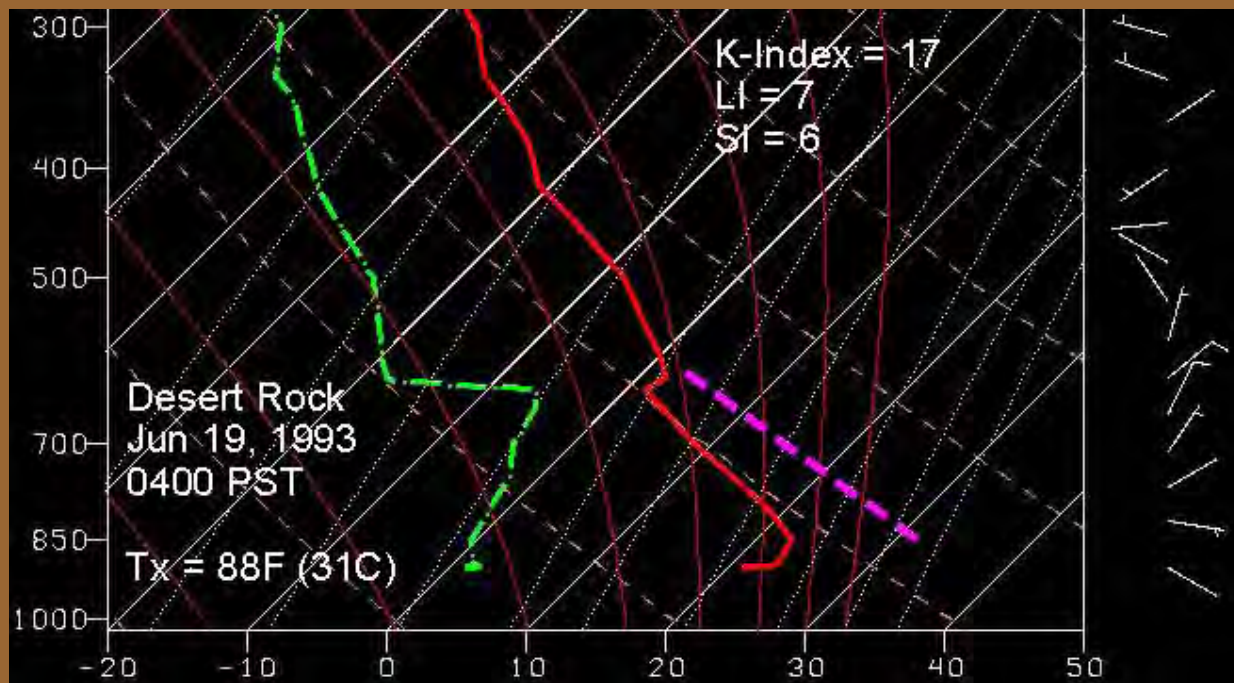


WMC 86/47

RNO 88/57

TPH 86/54

LAS 94/72





# Type #4: Building Ridge Aloft

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*2 Examples / Next 4 Slides*

 Temperature trend upward

- Surface temps climbing faster than aloft
- Subsidence not strong
- Large diurnal temperature spread in transition

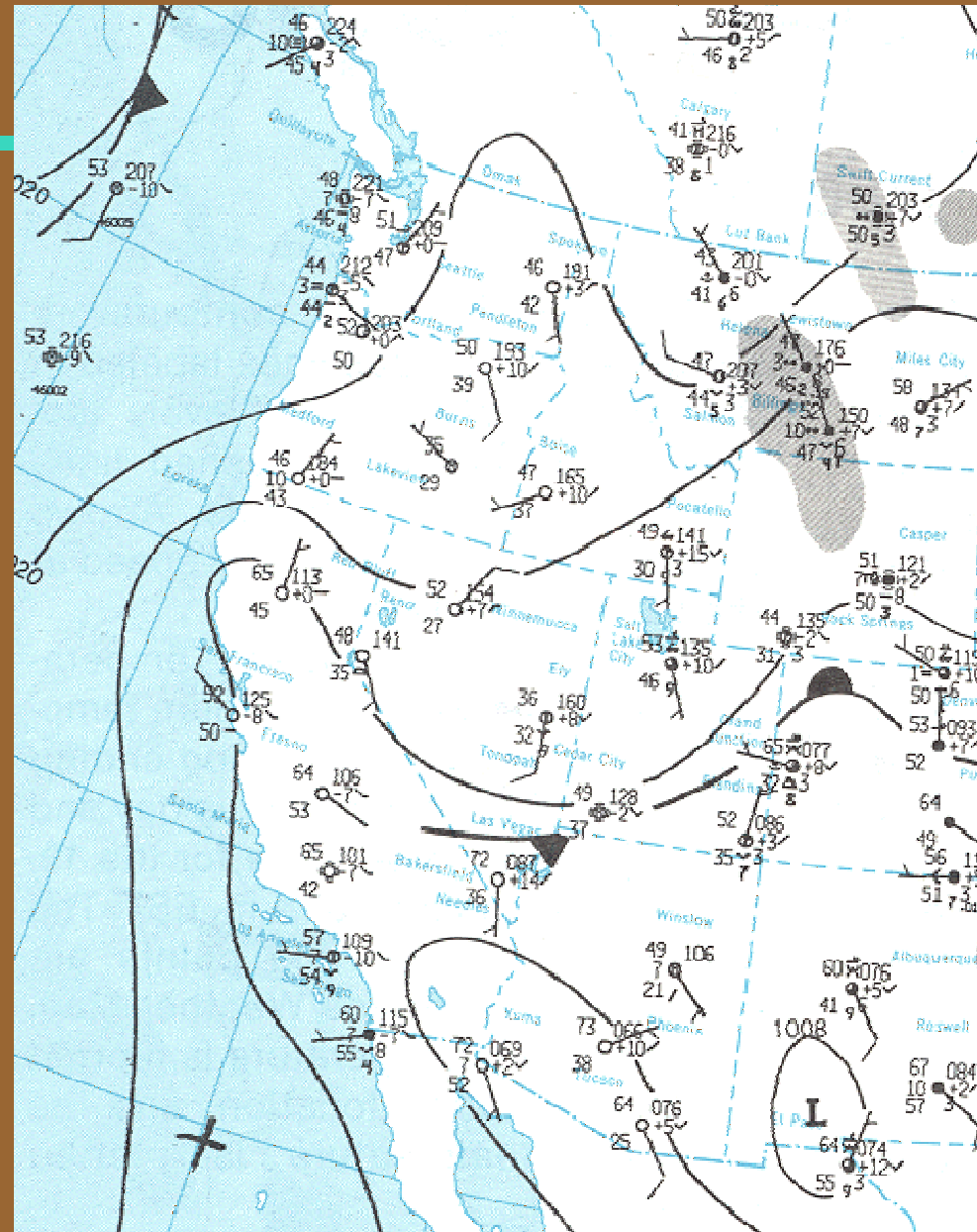
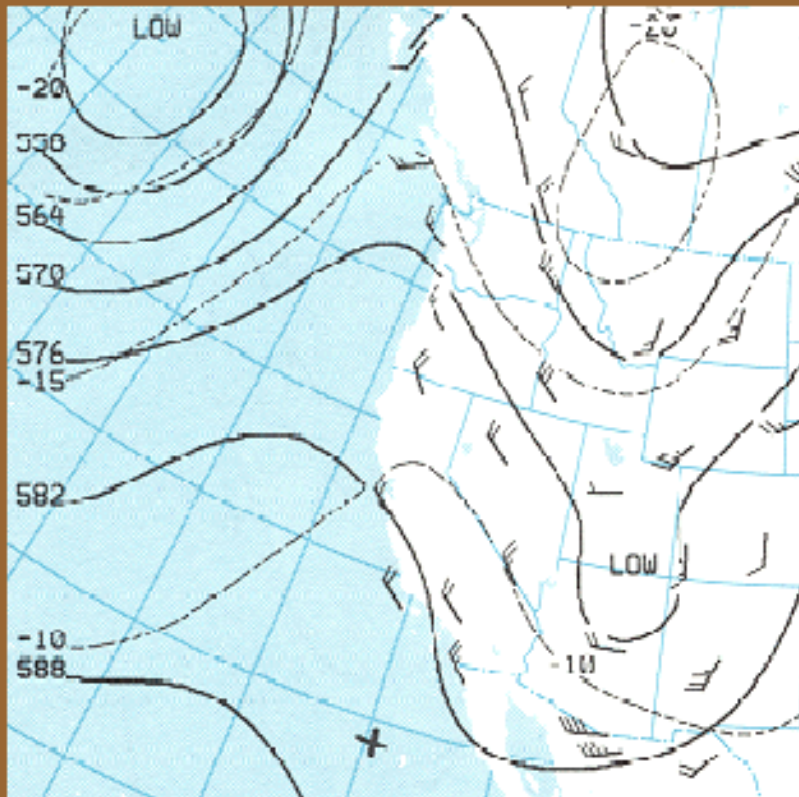
 Light wind aloft

- Height gradient small

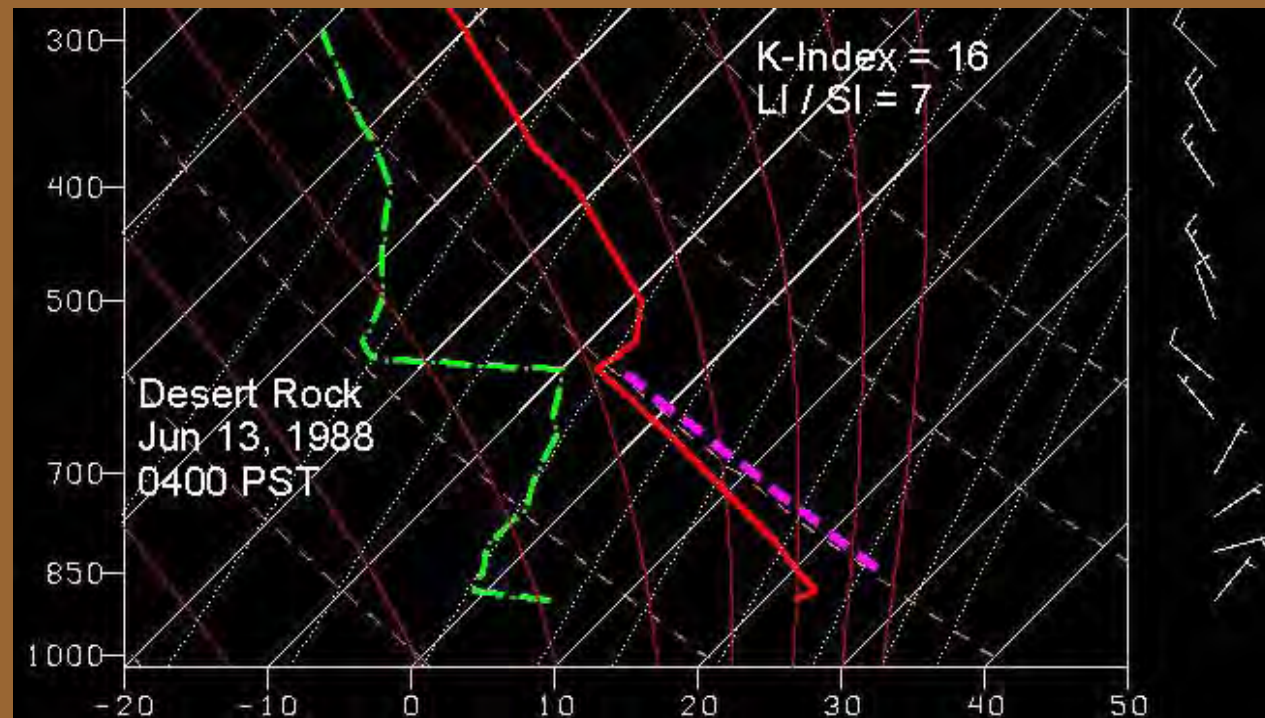
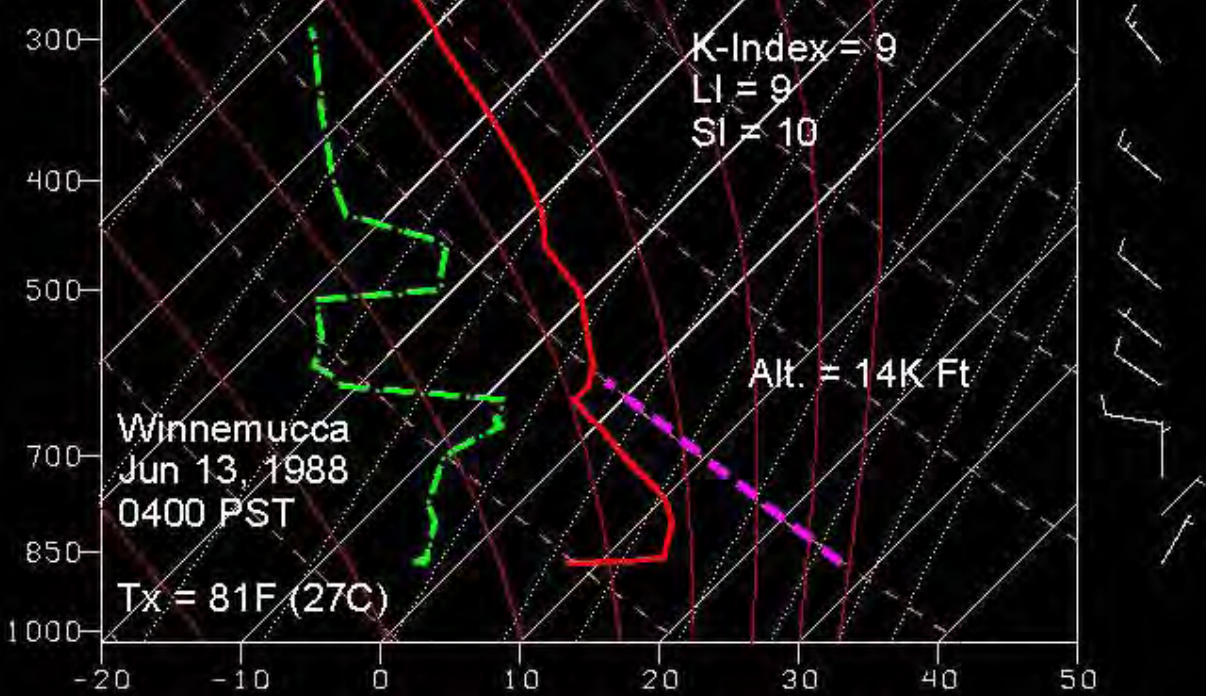
 Suppression of westerly washout

# Type #4: 6/13/88

500 Mile Flight



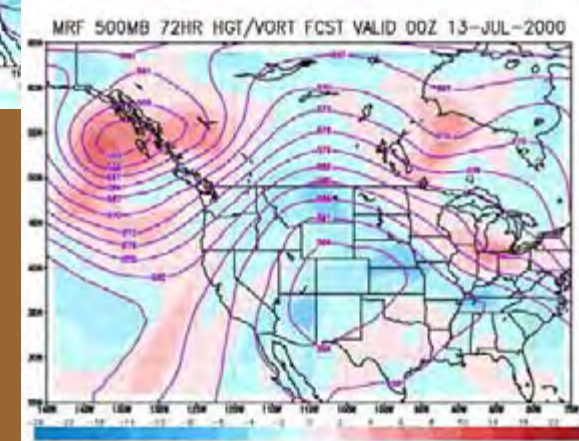
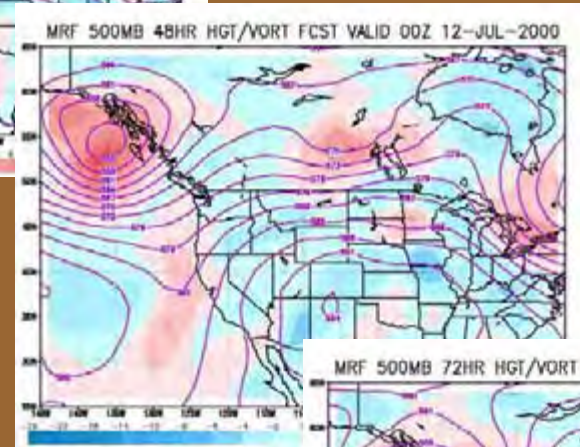
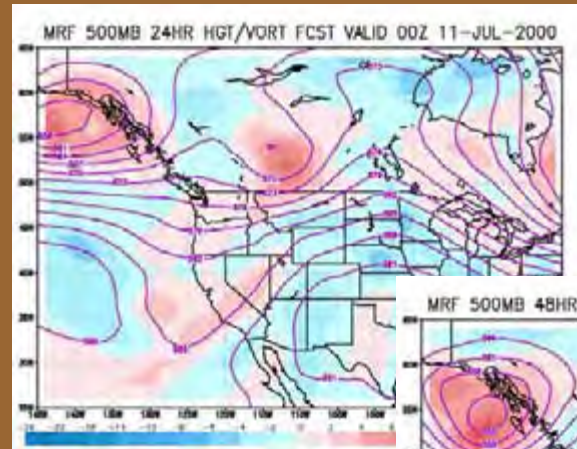
# 6/13/88 Raobs



- WMC 81/42
- RNO 81/27 (!!!)
- TPH 78/M
- LAS 95/70

# 4. Weather Forecasting

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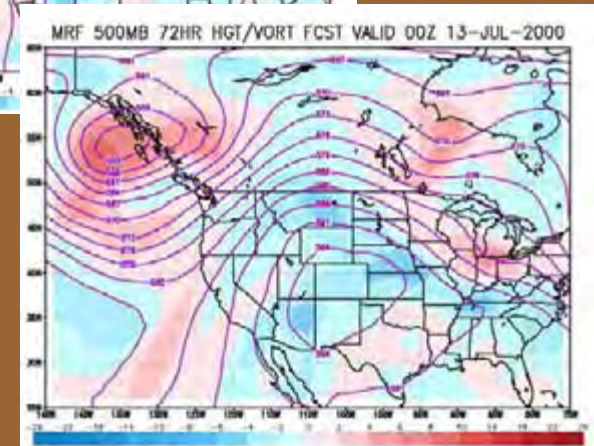
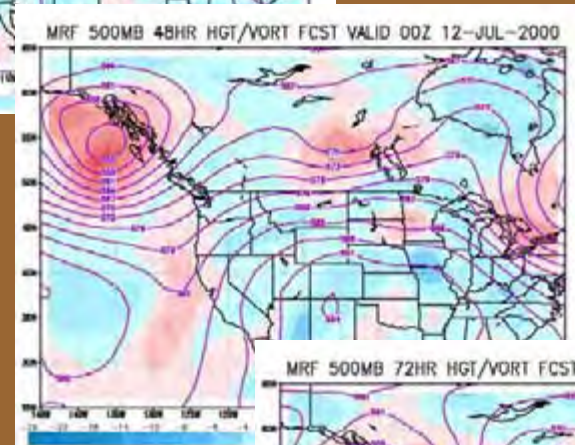
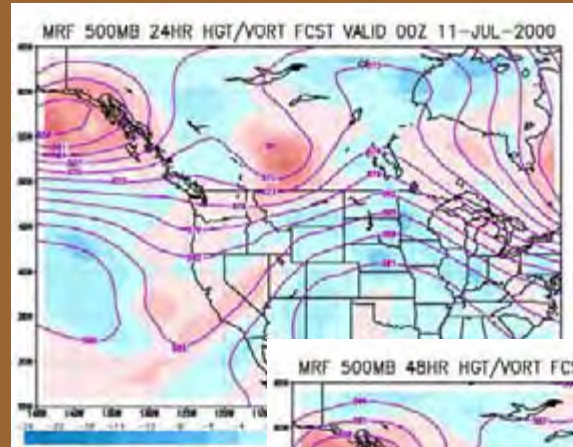


- Forecast Funnel
- Soaring Indices
- Automated Soaring Forecasts
  - Dr. Jack and BLIPMAP
  - Other Automated Forecasts
- NWS IFPS (Gridded Data)

# A Glider Pilot's Forecast Funnel

## *A Process of Soaring Forecast Refinement*

- Site Climate
- Outlook Forecasts
- Extended and Zone Forecasts (2-7 Day)
- Persistence
- Flight Day



# Soaring Indices (#3)

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## *Great Basin*

- Vertical Totals [☉T(deg C) 850 mb to 500 mb]
  - Upper 20s average to good
  - 30 to 34 very good
  - 35+ excellent (too unstable many times)

# Instability Indices<sup>(#1)</sup>

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## *Great Basin*

- K-Index

- Uses Vertical Totals and 2 fixed reference levels
  - ①  $T(C) + 850 \text{ dew point}(C) - 700 \text{ dew point depression}(C)$
- 5+ = some cumulus possibilities
- Thunderstorms increase in the 10-15 range

# Instability Indices (#2)

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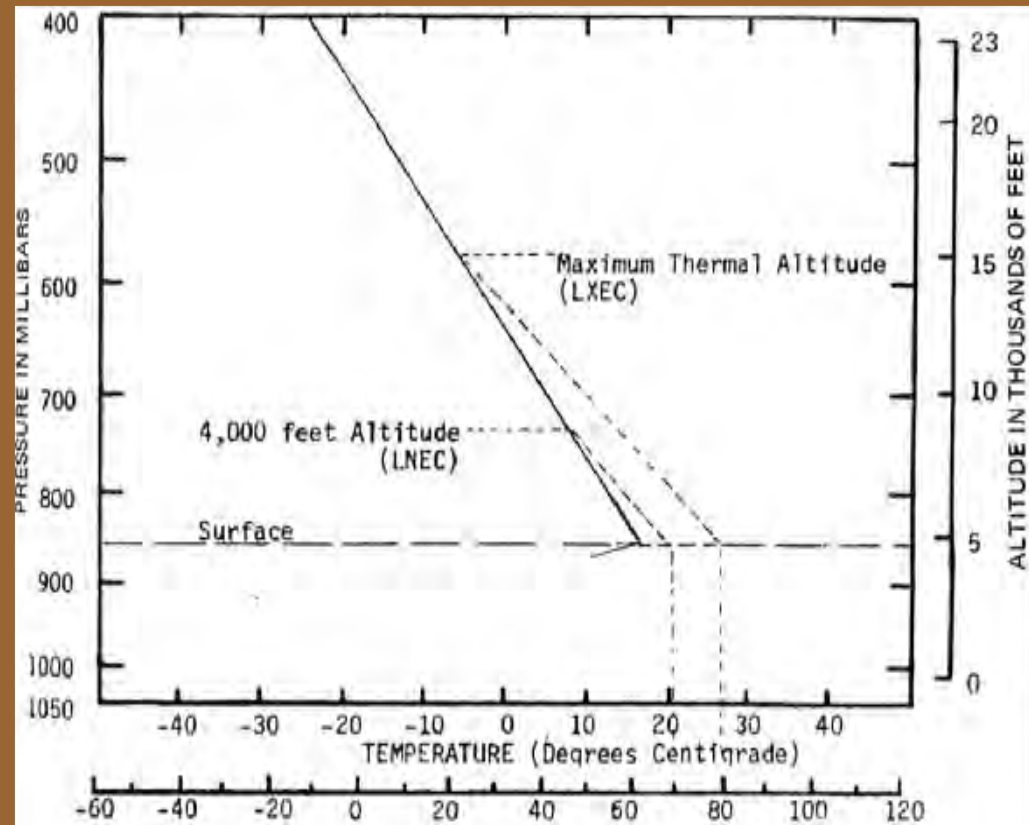
## *Great Basin*

- Lifted Index (LI) and Showalter Index (SI)
  - Lower layer moisture influences on the convection process / thunderstorm indicator
    - $> 10$  stable (weak convection)
    - $< -4$  too unstable (severe weather)



# Thermal Lift Indices

- Thermal Index (Williams/Higgins)
- Maximum Lift (Lindsay/Lacy)
- Soaring Support (Aldrich/Marsh)
- Soaring Index (Armstrong-Hill)

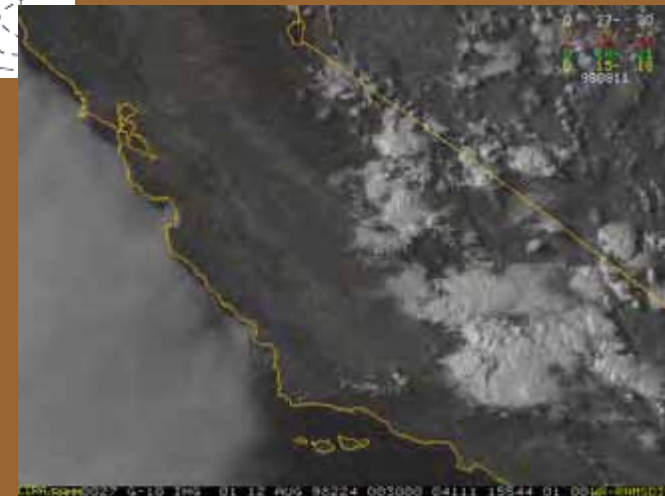
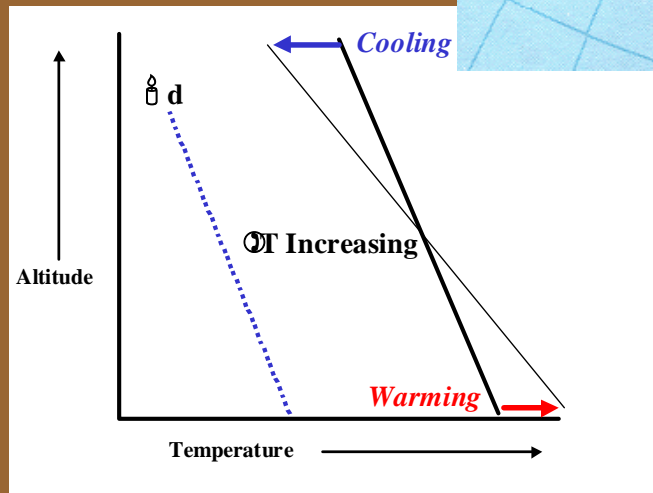
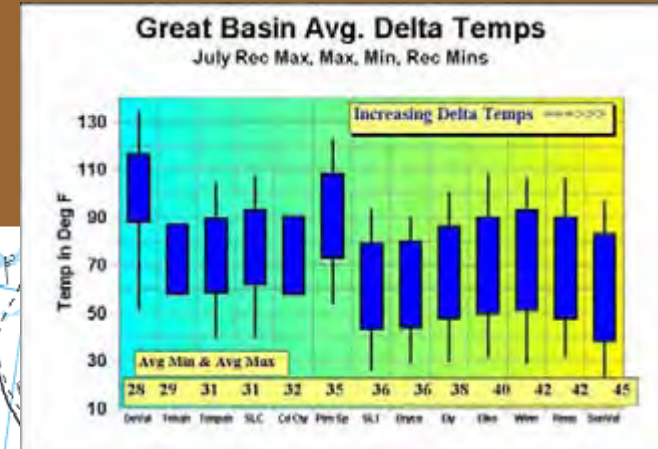
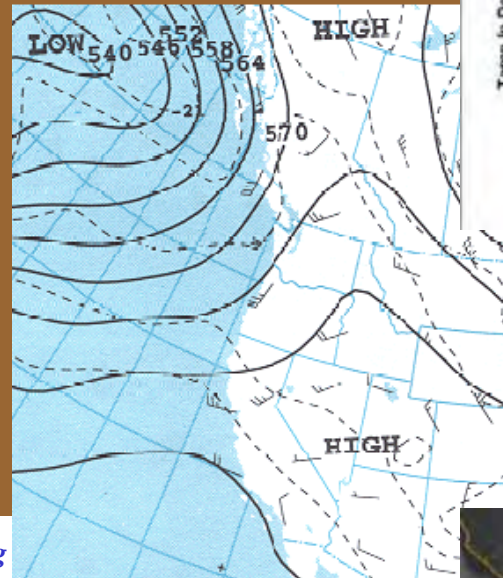


Thermal Fig. 5. The soaring index is computed for the maximum thermal altitude of 15,000 ft and difference of 13° C (LNEC (8° C) minus LXEC (-5° C). In the following formula:

$$\text{Soaring index} = 3 \left( \frac{1.5 \times 10^4}{10^2} + 1.3 \times 10^2 \right) = 840$$

# Traditional Soaring Forecasts

- Persistence
- Nowcasting
  - Soundings
  - Satellite
  - Analysis
- Algorithm Use



# Digital Database

## Graphical Display of Requested Weather Parameter(s)

Warnings & Forecasts | Graphical Forecasts | National Maps | Radar | Rivers | Air Quality | Satellite | Climate

### Graphical Forecasts - Reno, NV

Public Fire Weather

Daily View | Weekly View | Loops

Mouse over the table below to change the forecast image.

Today	<input type="button" value="12hrs"/> <input type="button" value="+12hrs"/>			
Max/Min Temperature	High			
Probability of Precip.	12 hr. probability			
Weather	7am	10am	1pm	4pm
Temperature	7am	10am	1pm	4pm
Dewpoint	7am	10am	1pm	4pm
Wind Speed & Direction	7am	10am	1pm	4pm
Sky Cover	7am	10am	1pm	4pm
Amount of Precip.	QPF		QPF	
Snow Amount	Snow Amount		Snow Amount	
Next Image	<input type="button" value="Previous"/> <input type="button" value="Next"/>			

Table MouseOver Effect On

NWS Reno, NV

## Digital Forecast Products

HOME NEWS ORGANIZATION

Use the form below to select forecast options:

- Select desired forecast display style...  
 Display Format:  (with map displayed) |  Internet Explorer 5.0 or greater (no map displayed)
- Select desired forecast duration...  
 Number of days:  1 day |  2 day |  3 day  
 Forecast interval in hours:  1 hour |  3 hours
- Select desired forecast location...  
 You may select a city:

or, select a latitude and longitude  
 Lat:  (degrees N, e.g., 47.46) Lon:

or click a location on the map:  
 Zoom (for more detail, select Zoom, then click on map)



# Soaring Weather Forecasting

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