Soaring Weather Forecasting

PASCO Safety Seminars
November 2006

Dan Gudgel
Meteorologist/Towpilot/CFIG

Presentation Points

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

1. Weather Information Sources

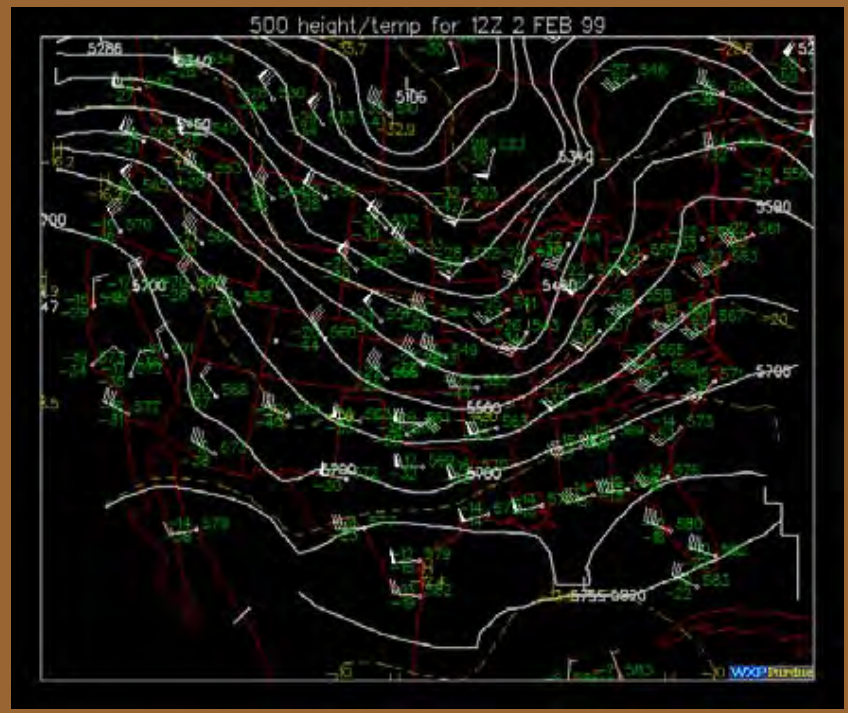
Weather Data

- 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>

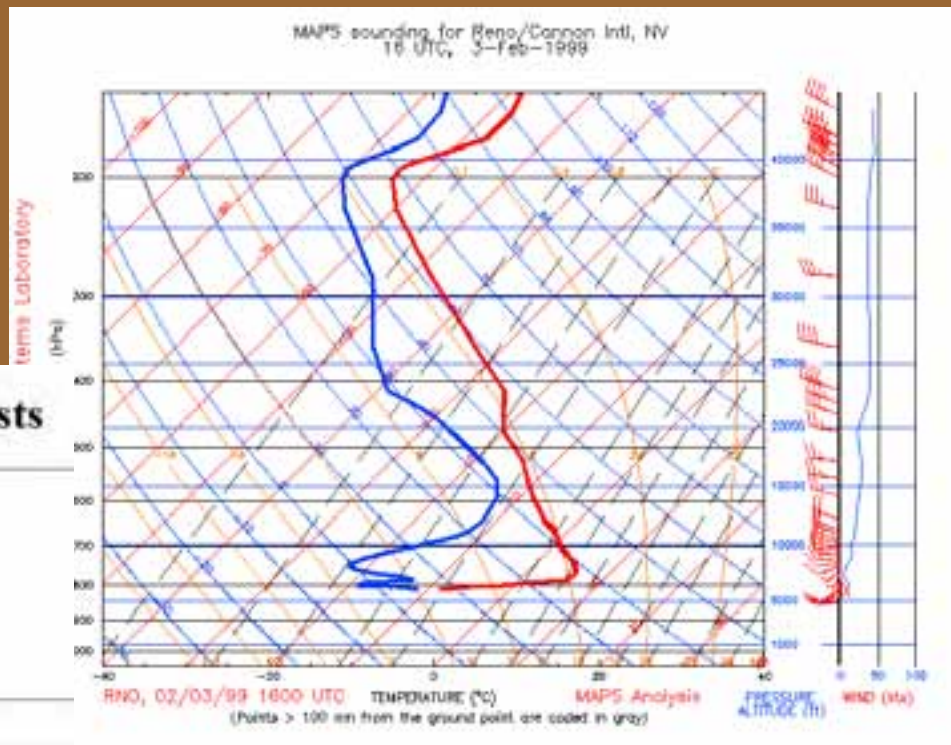
- NWS National Homepage
  - Select area of interest (‘clickable’ map)
- All Western Region NWS Offices listed

- 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: 06 month: Nov day: 1 hour: 19 UTC

Location: Longitude: -104.67 Latitude: 39.87 OR:

Airport ID: (none) (overrides lat/lon) (list of airports)

Plot sounding

-- OR --

Always get the latest MAPS sounding for a particular location.

(Bookmark the following page)

Input Data Source: MAPS or RUC-2

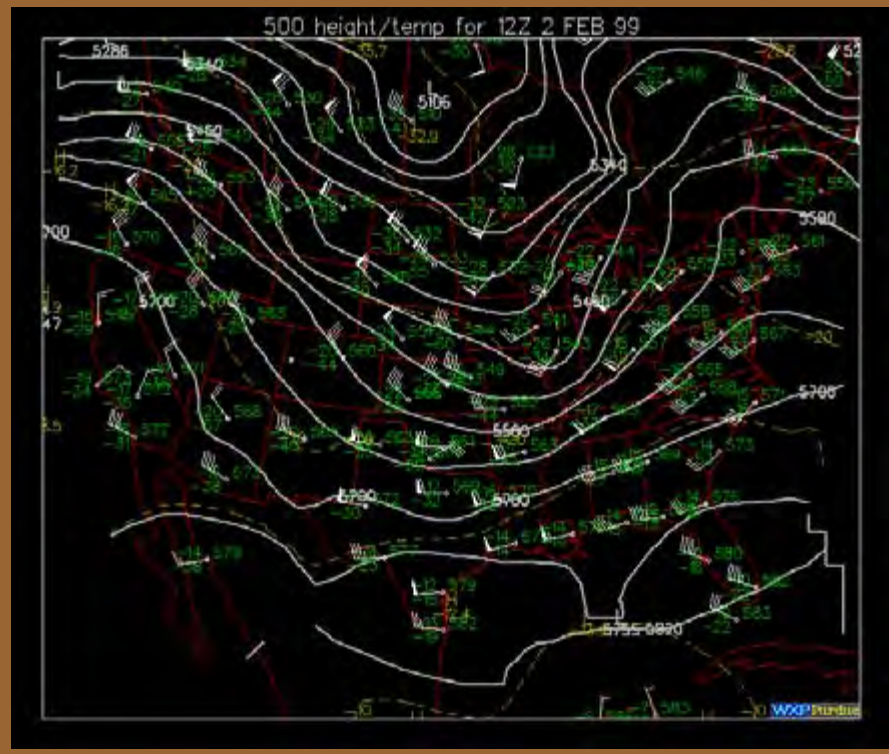
Location: Longitude: -104.67 Latitude: 39.87 OR:

Airport ID: RNO (overrides lat/lon) (list of airports)

Unisys Weather

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

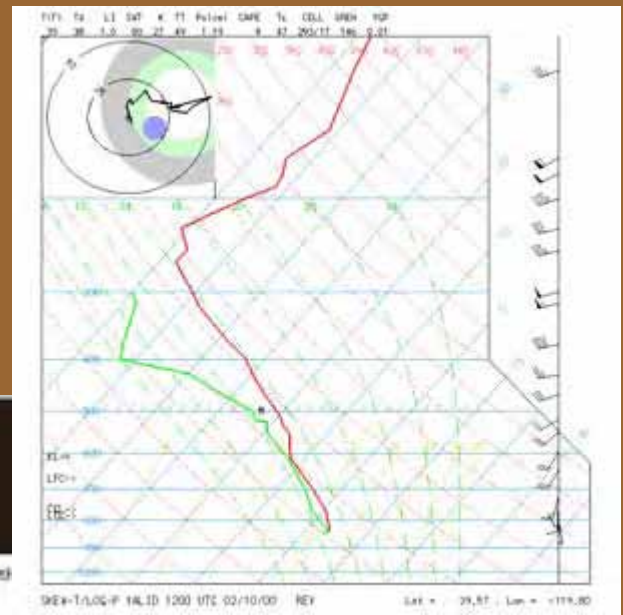
- Upper Air Temperature Soundings
- Constant Pressure Charts
- Model Forecast Charts
- Education / Explanations



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

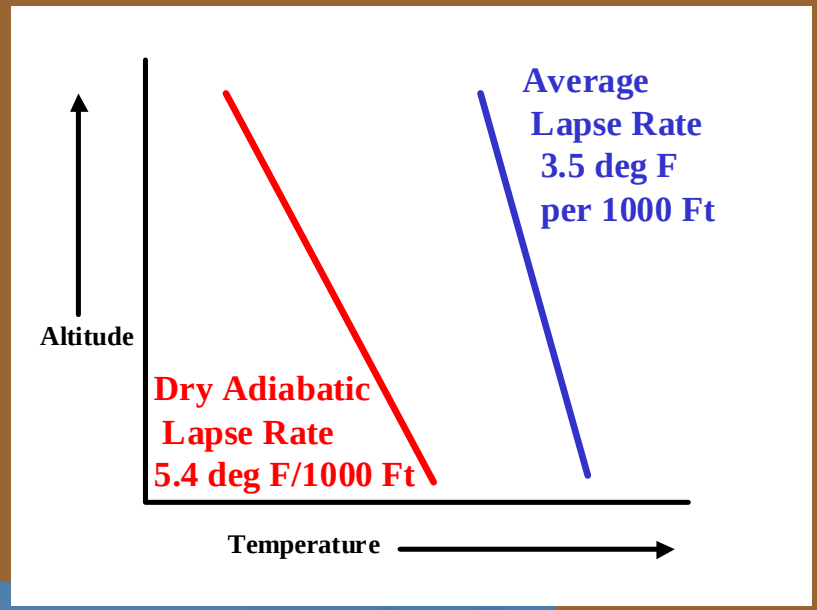
<http://www.rap.ucar.edu/weather/>

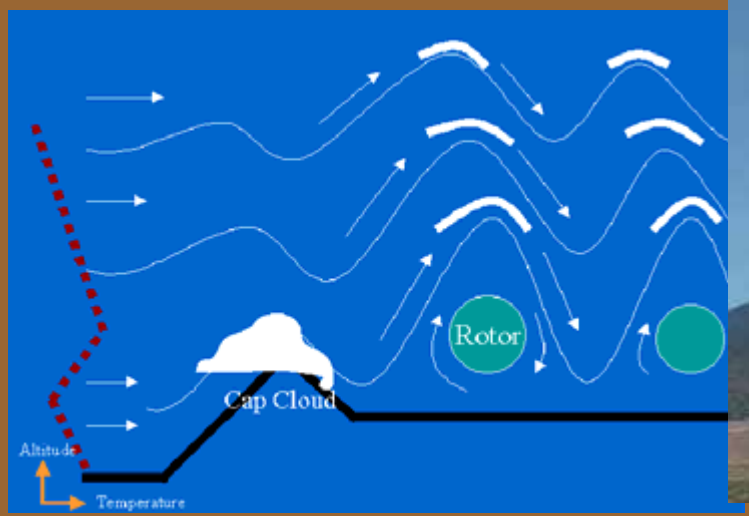
- Upper Air Data (Temp/RH/Wind Info)
- Other weather data

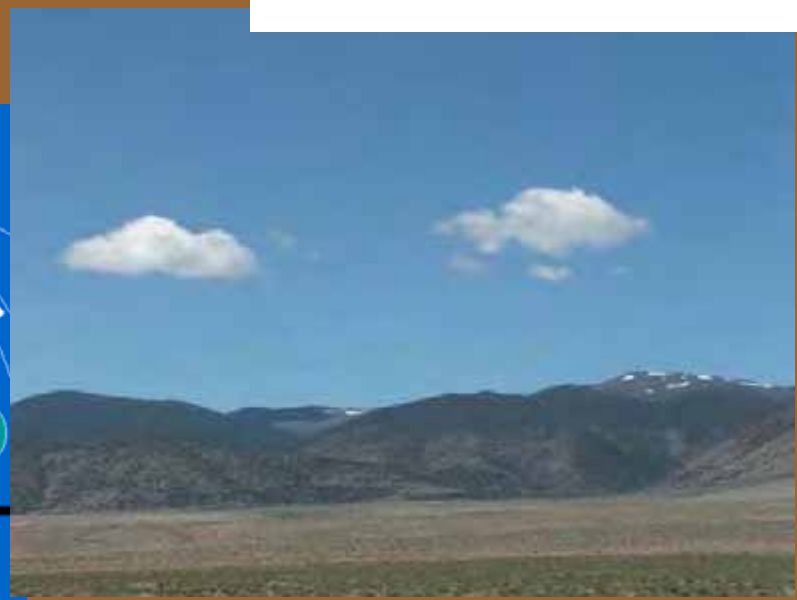


2. Meteorology Points

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

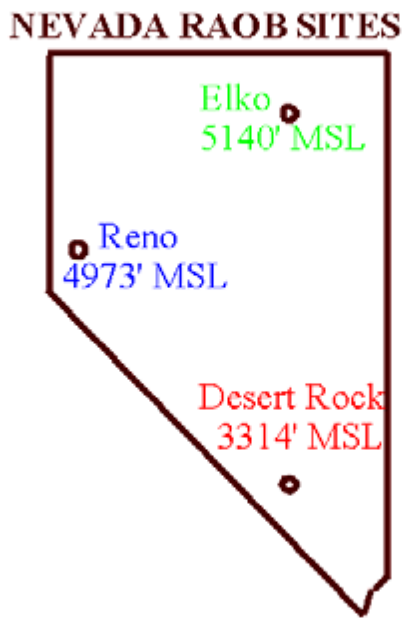






Sounding Basics

- 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



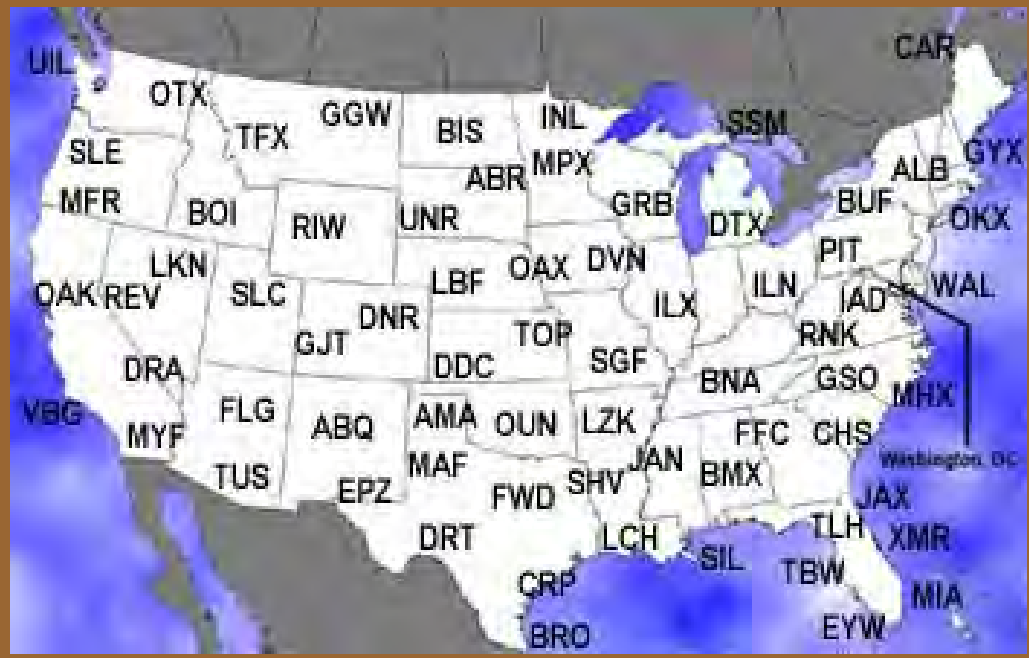
Sounding Sources

- University of Utah Upper Air Link

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

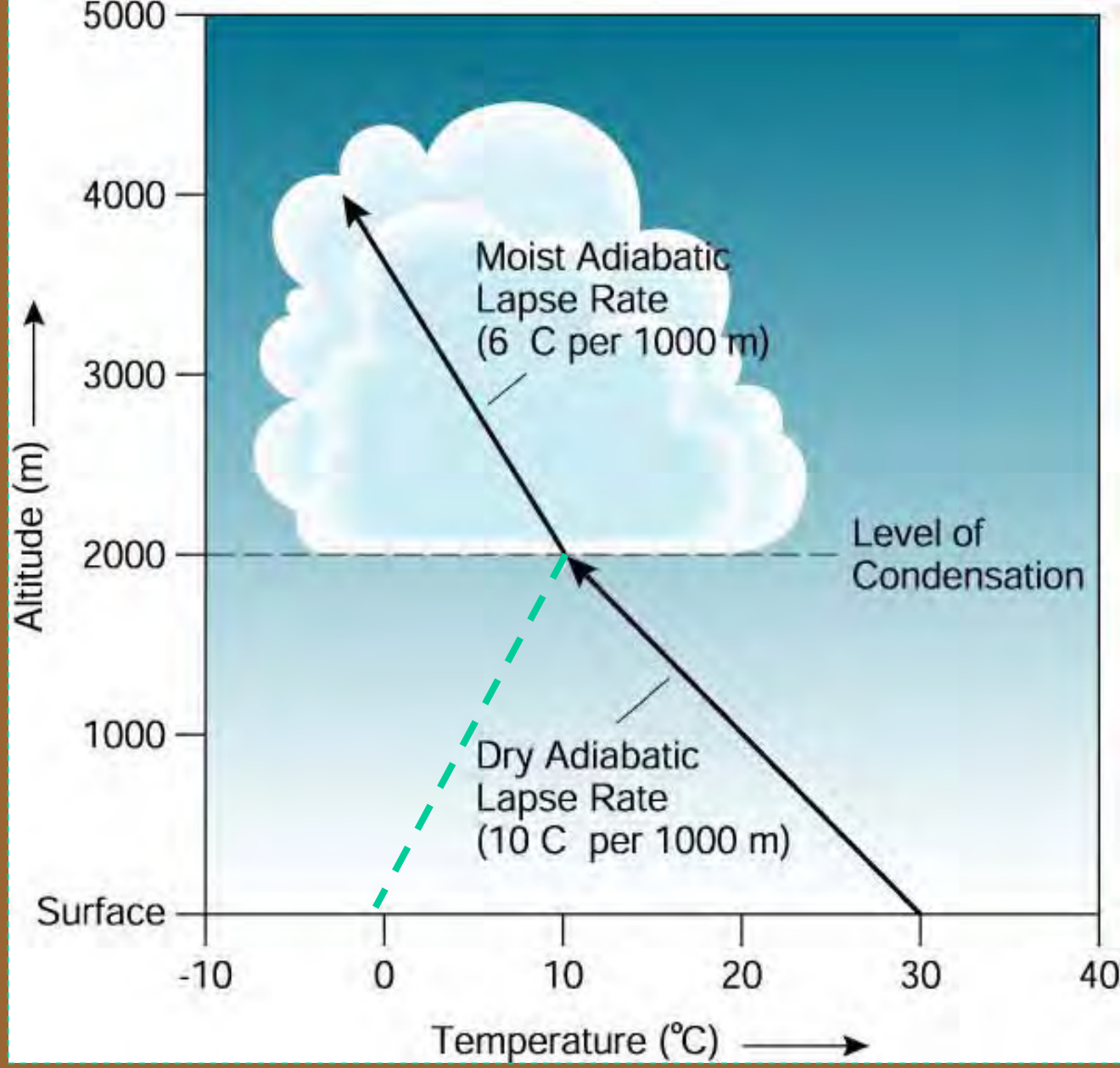
- Unisys Weather Upper Air Link

  http://weather.unisys.com/upper_air/skew/index.html



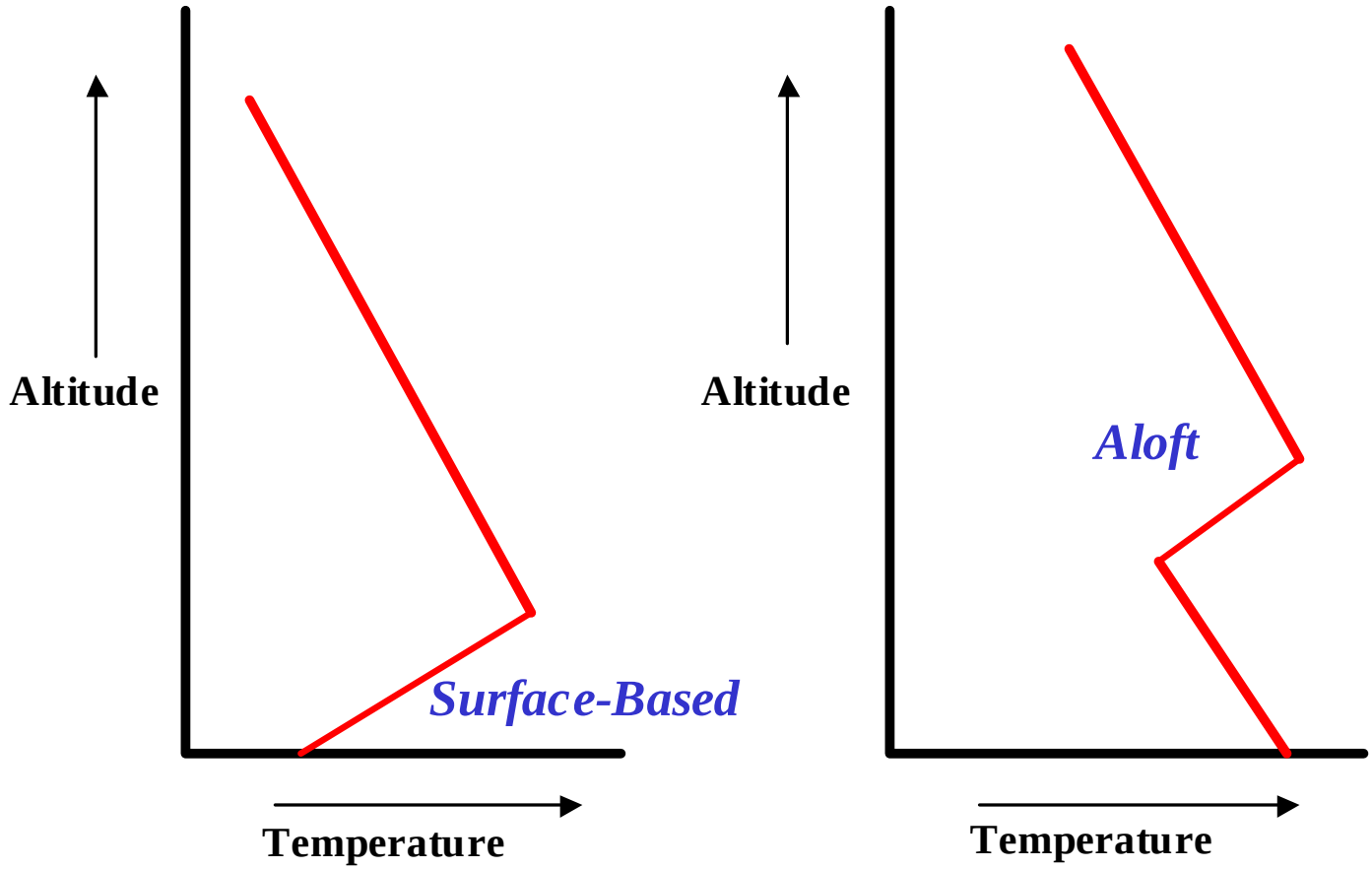
Lapse Rates

Dry
and
Moist
Adiabatic



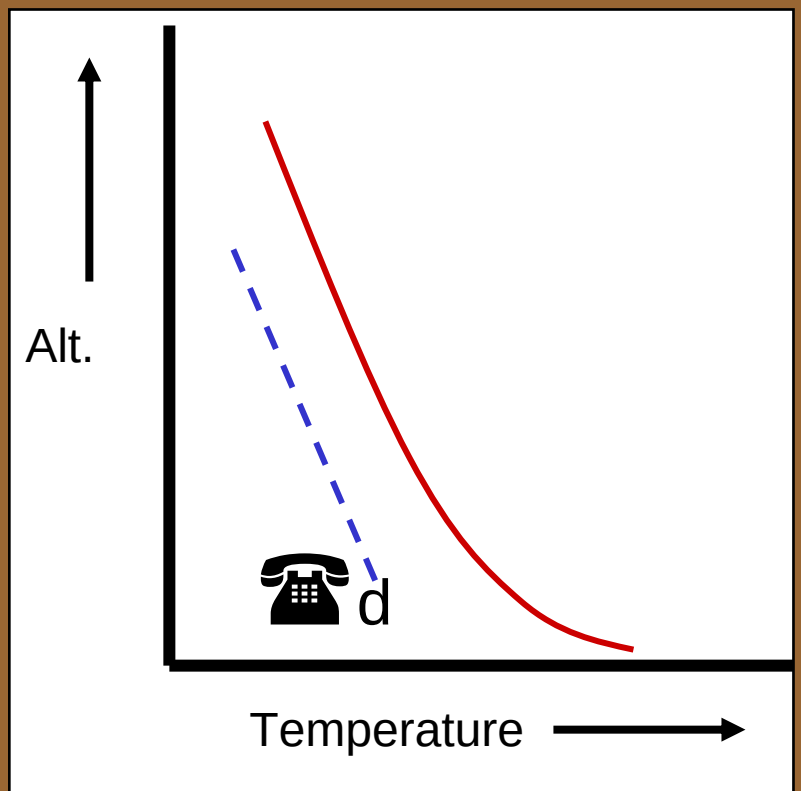
Temperature Inversions

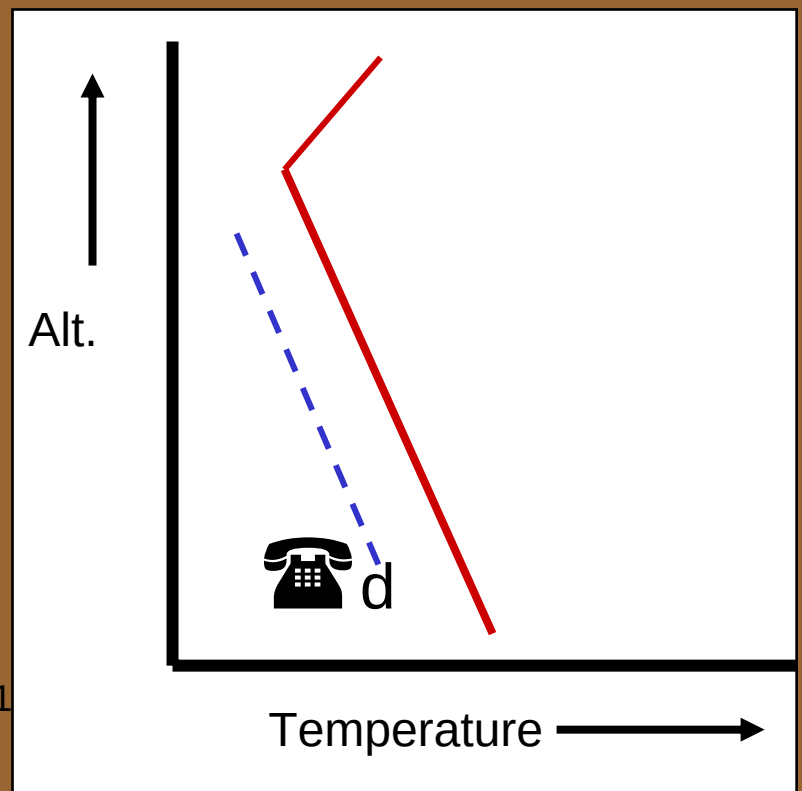
Surface-Based and Aloft



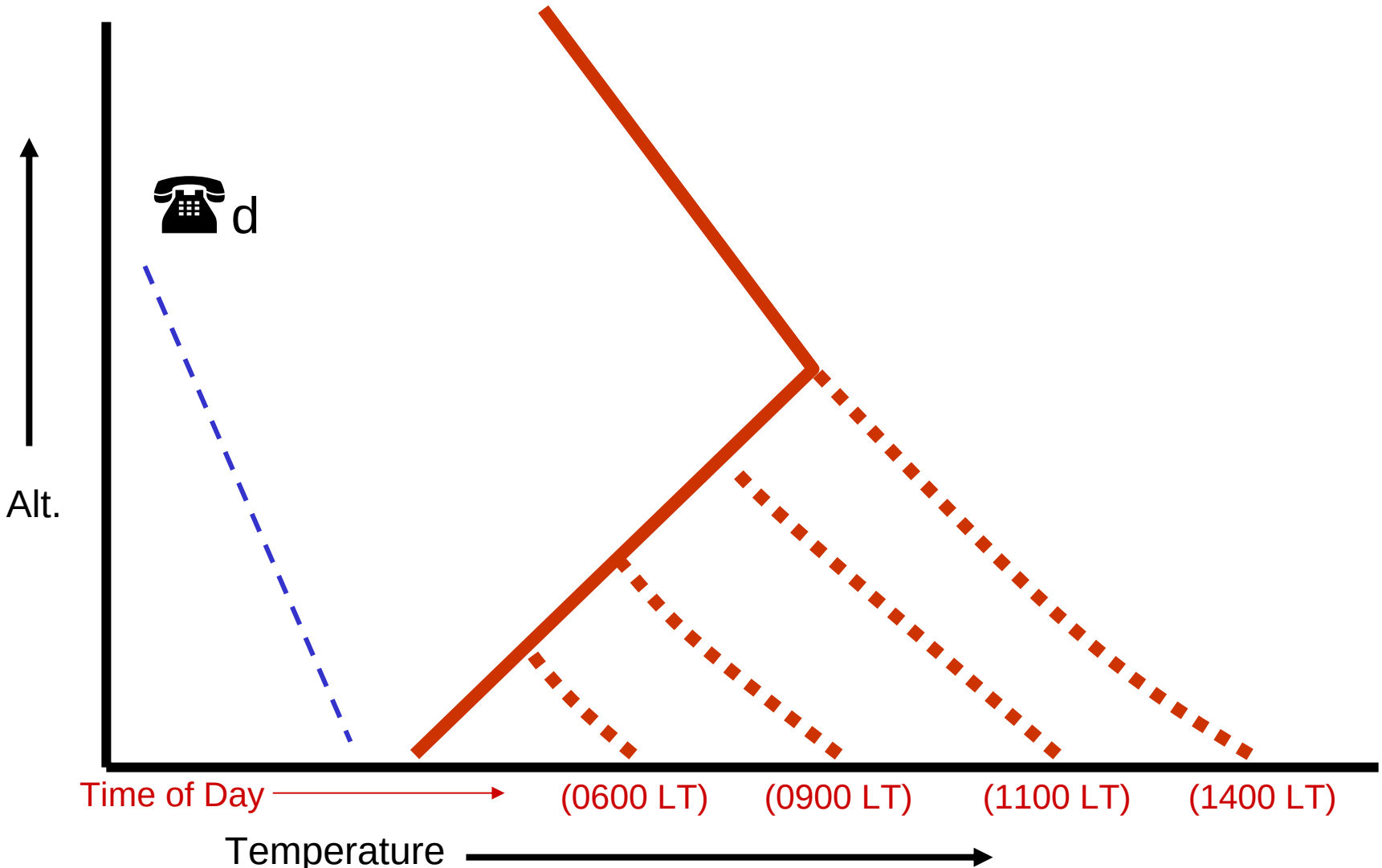
Profiles

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



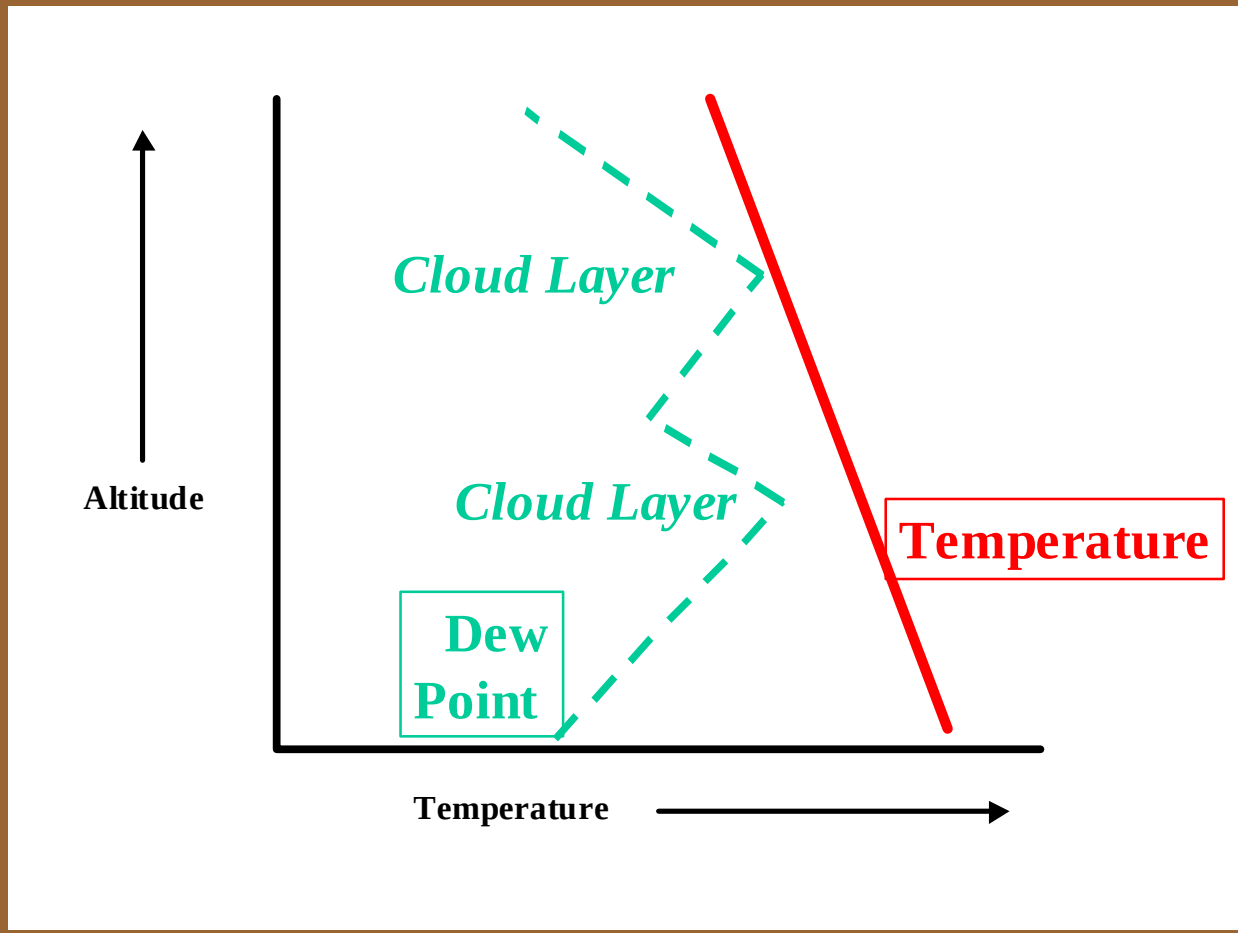


Surface-Based Inversion Erosion with Time

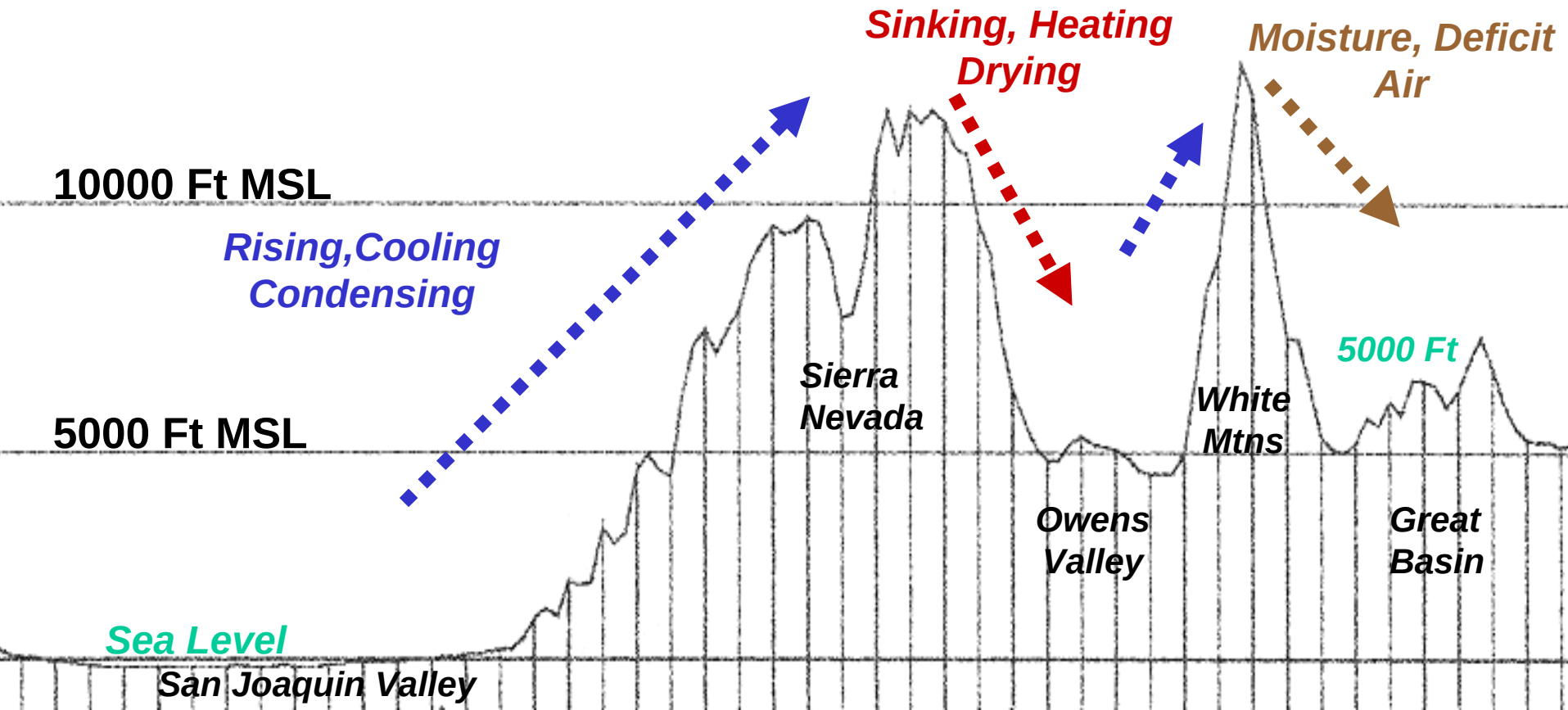


Cloud Base / Moisture Layers

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



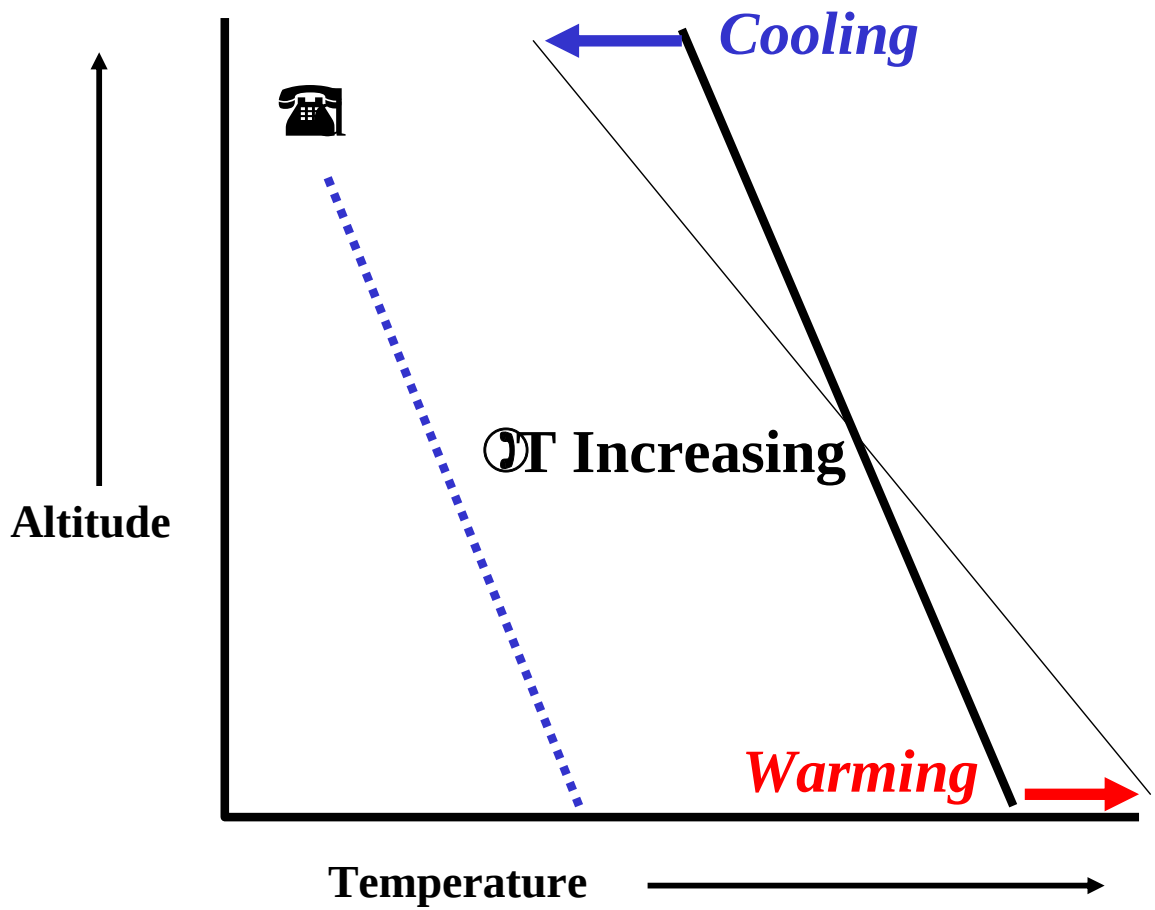
The Drying Process



De-Stabilizing Process

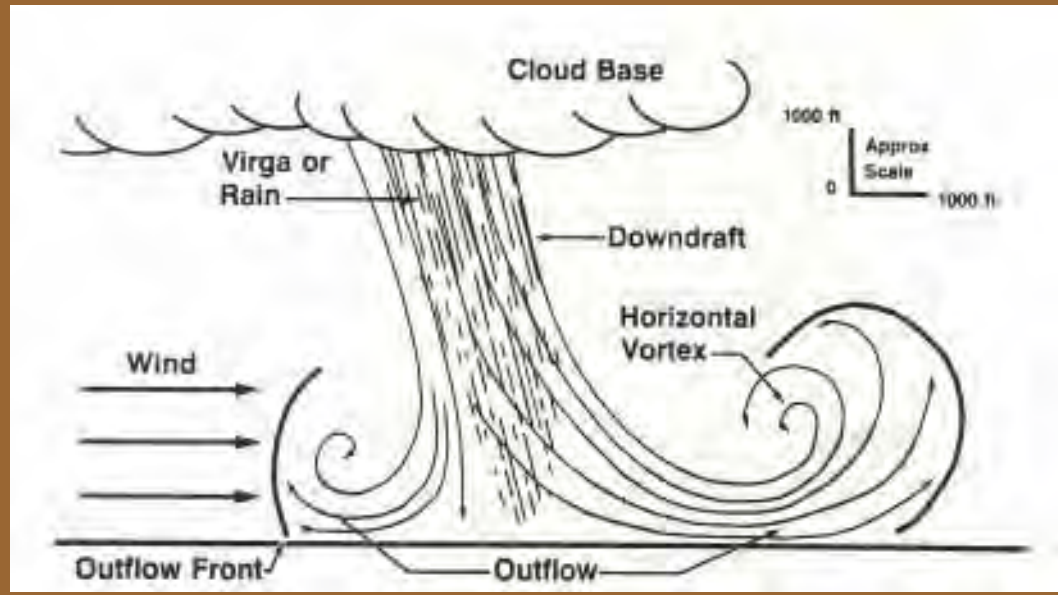
Colder Air Advection above, and/or
Warm Air Advection below will de-stabilize

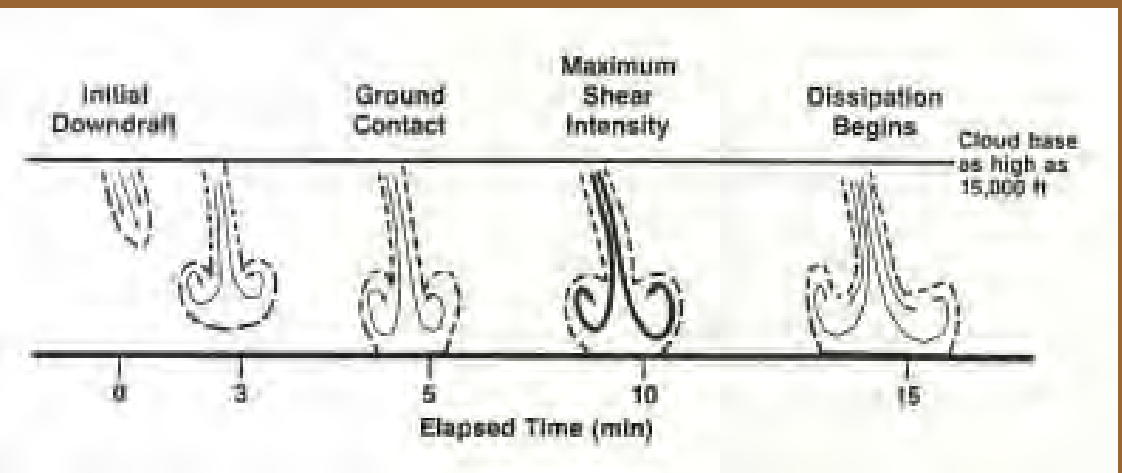
- Delta-T increase!
- Moisture presence also de-stabilizes



Basin Thunderstorm / Microbursts

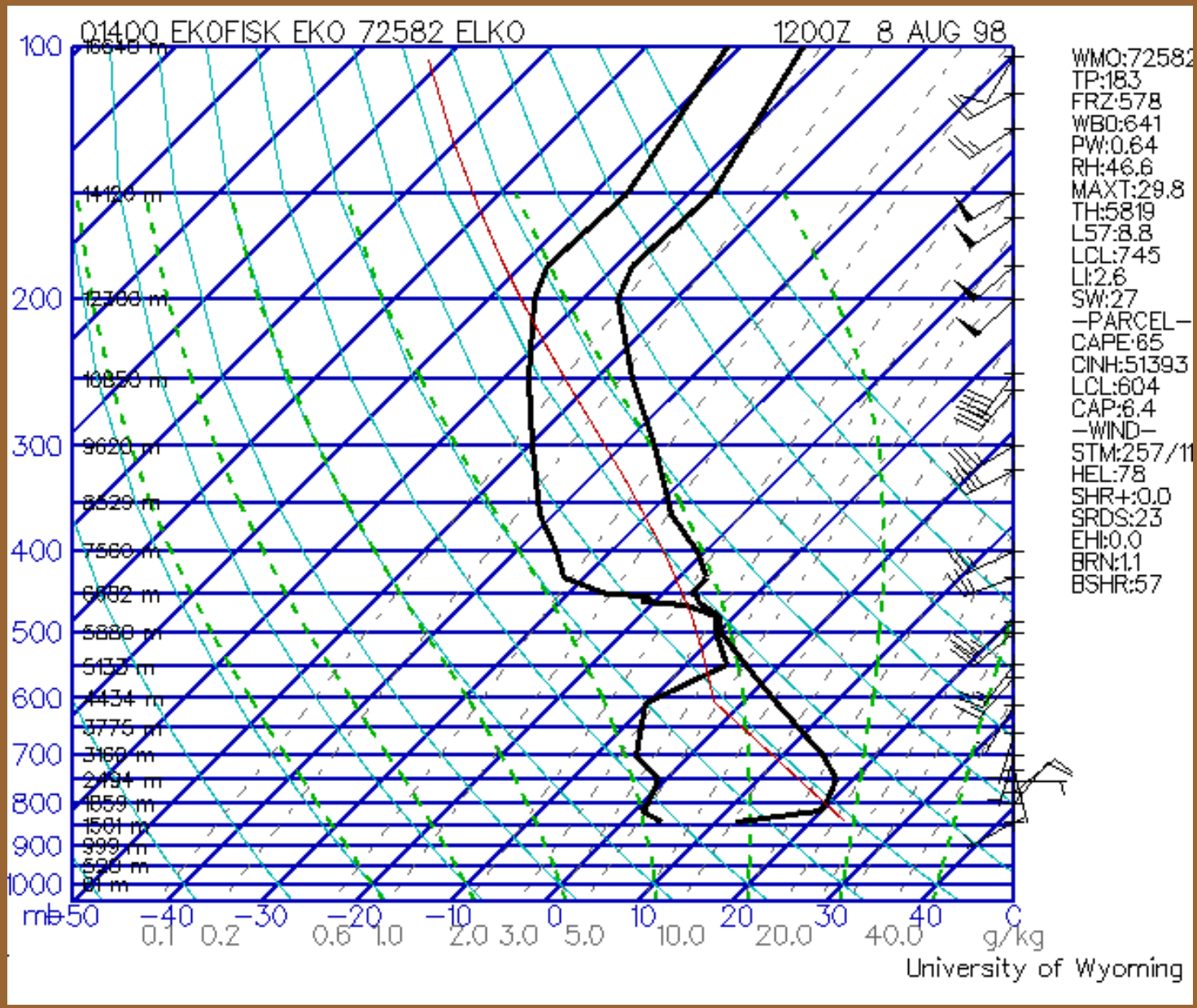
- Develop Adjacent cells
- Classic short duration
- 60Kt+ Sink Rates
- Regardless of cell size
- Wind shifts
- Degrade ceiling and visibility



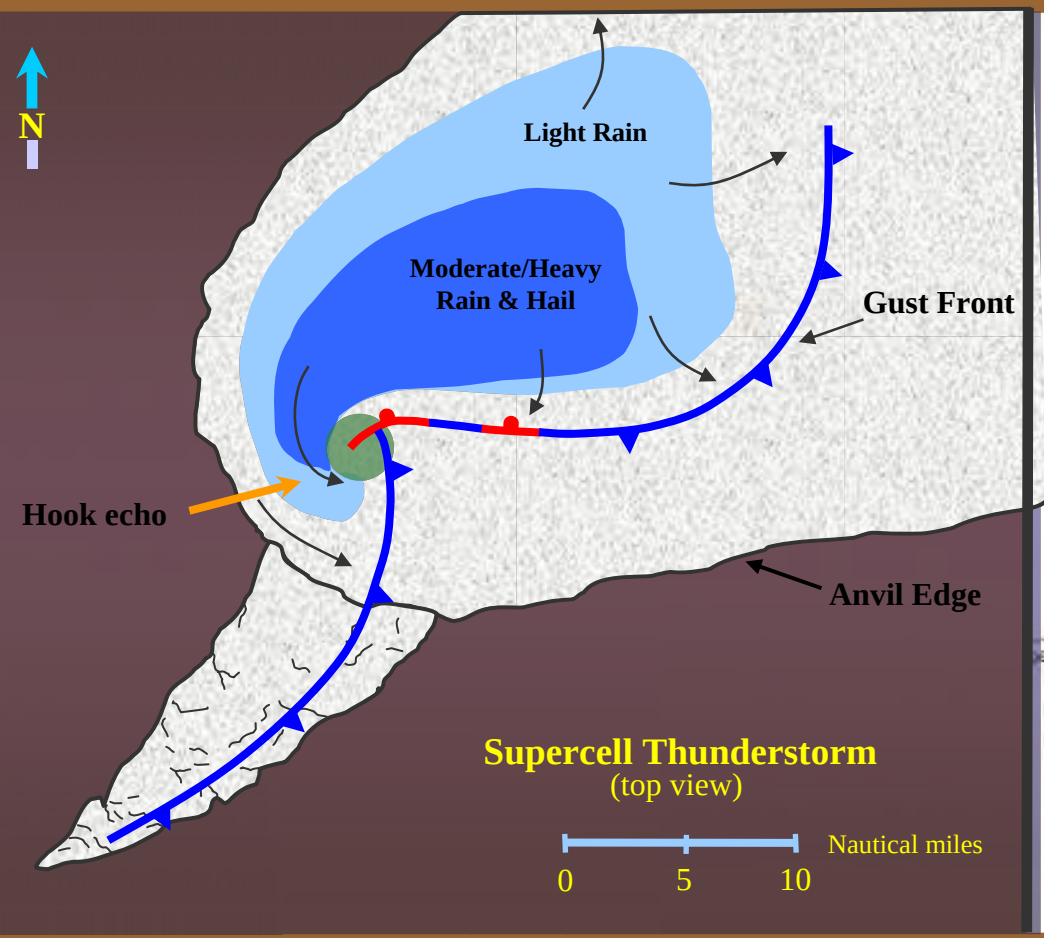


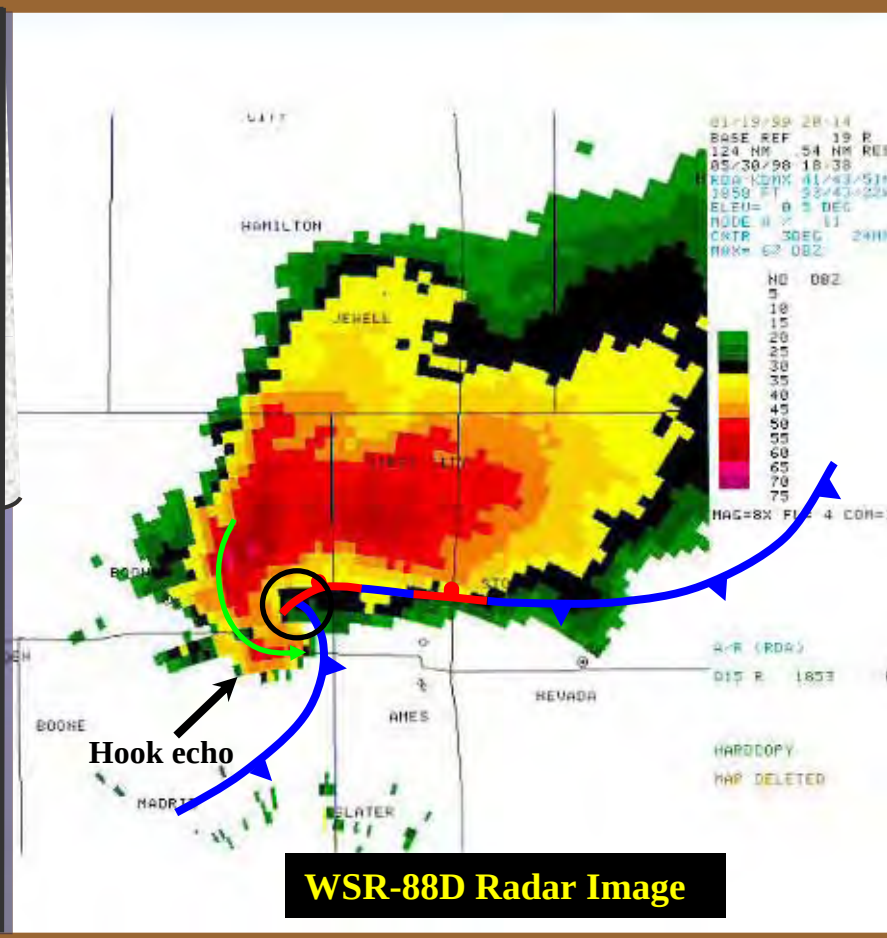

Mojave Desert Downburst
Courtesy of Caracole Soaring, California City, CA

Microburst Sounding



Classic Supercell Thunderstorm

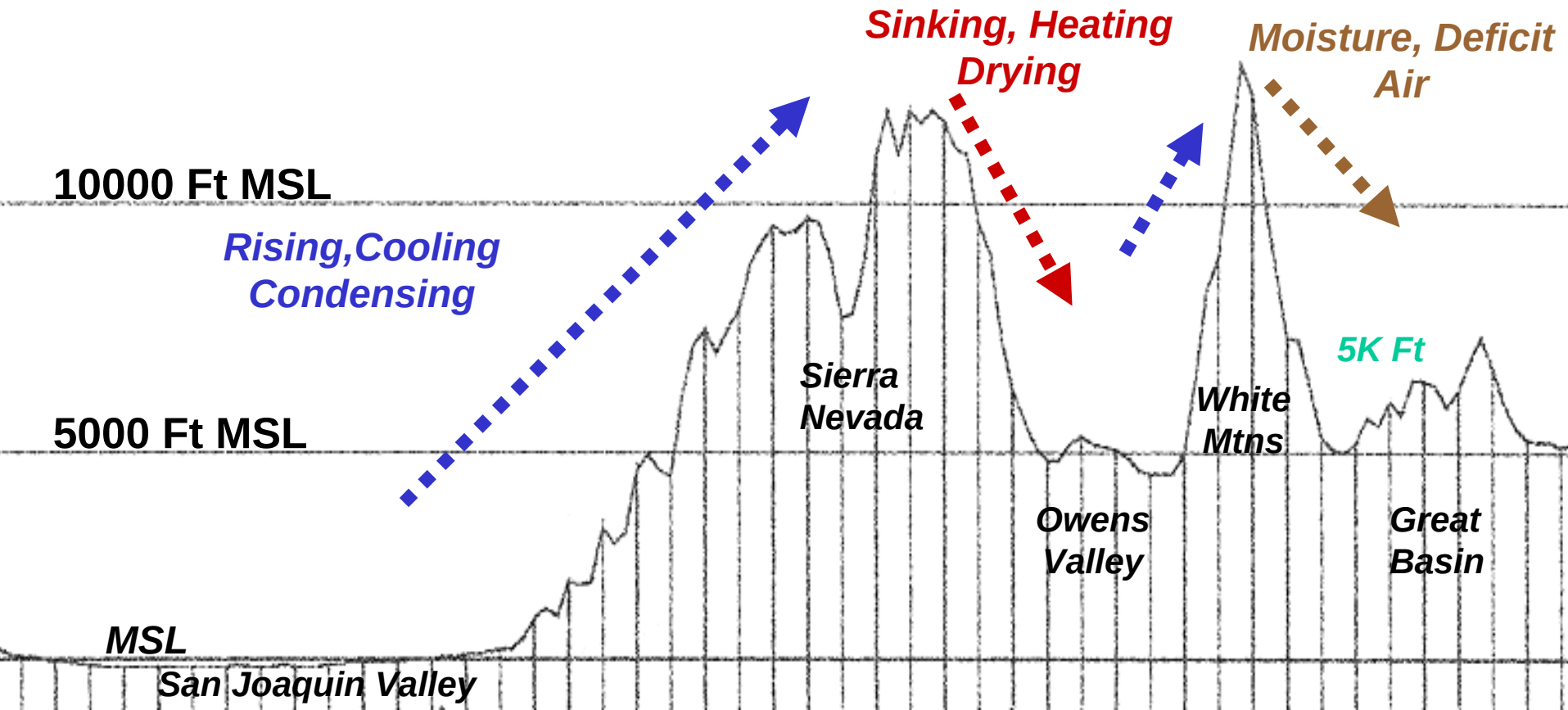




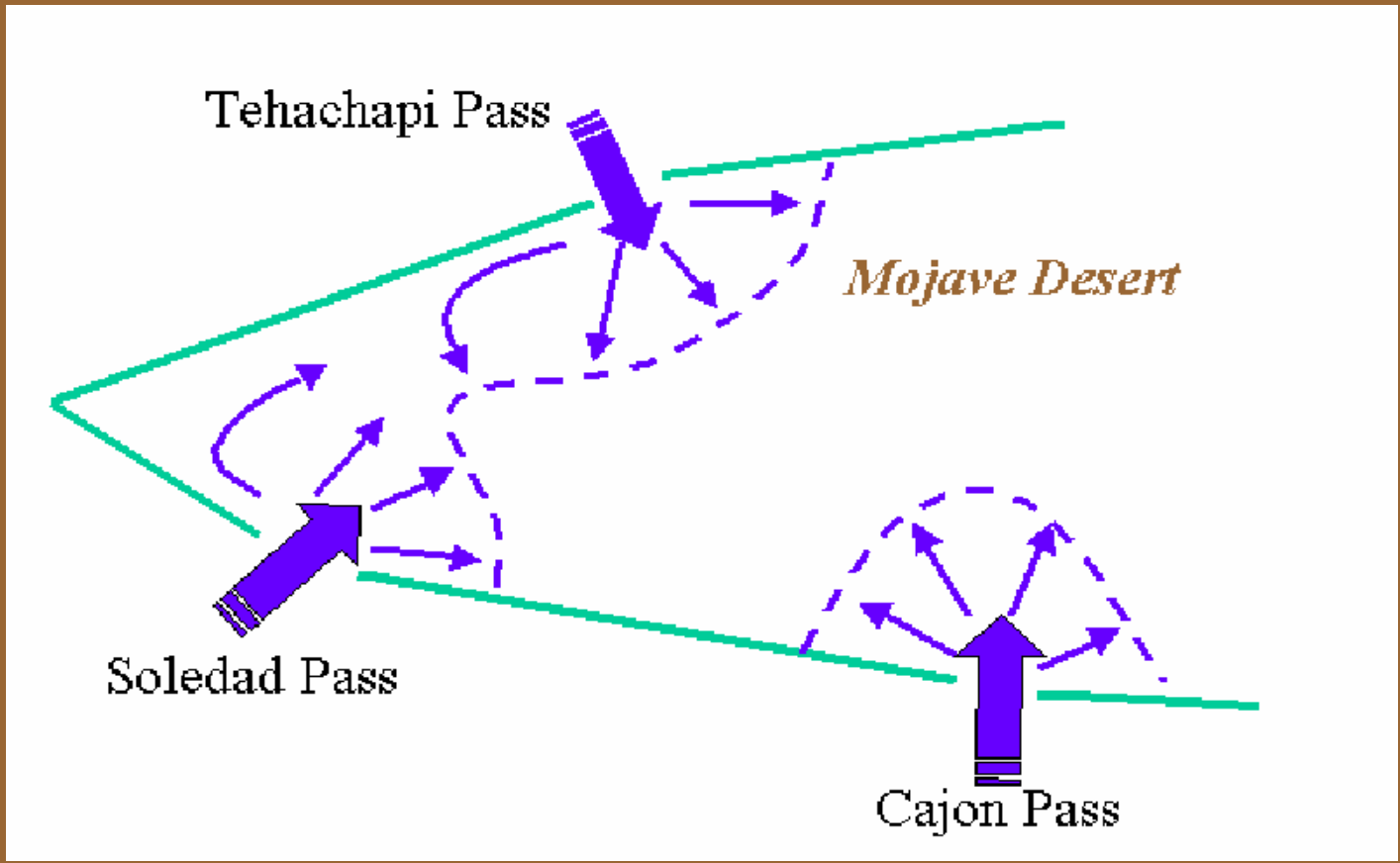
Climate and Other Influences

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

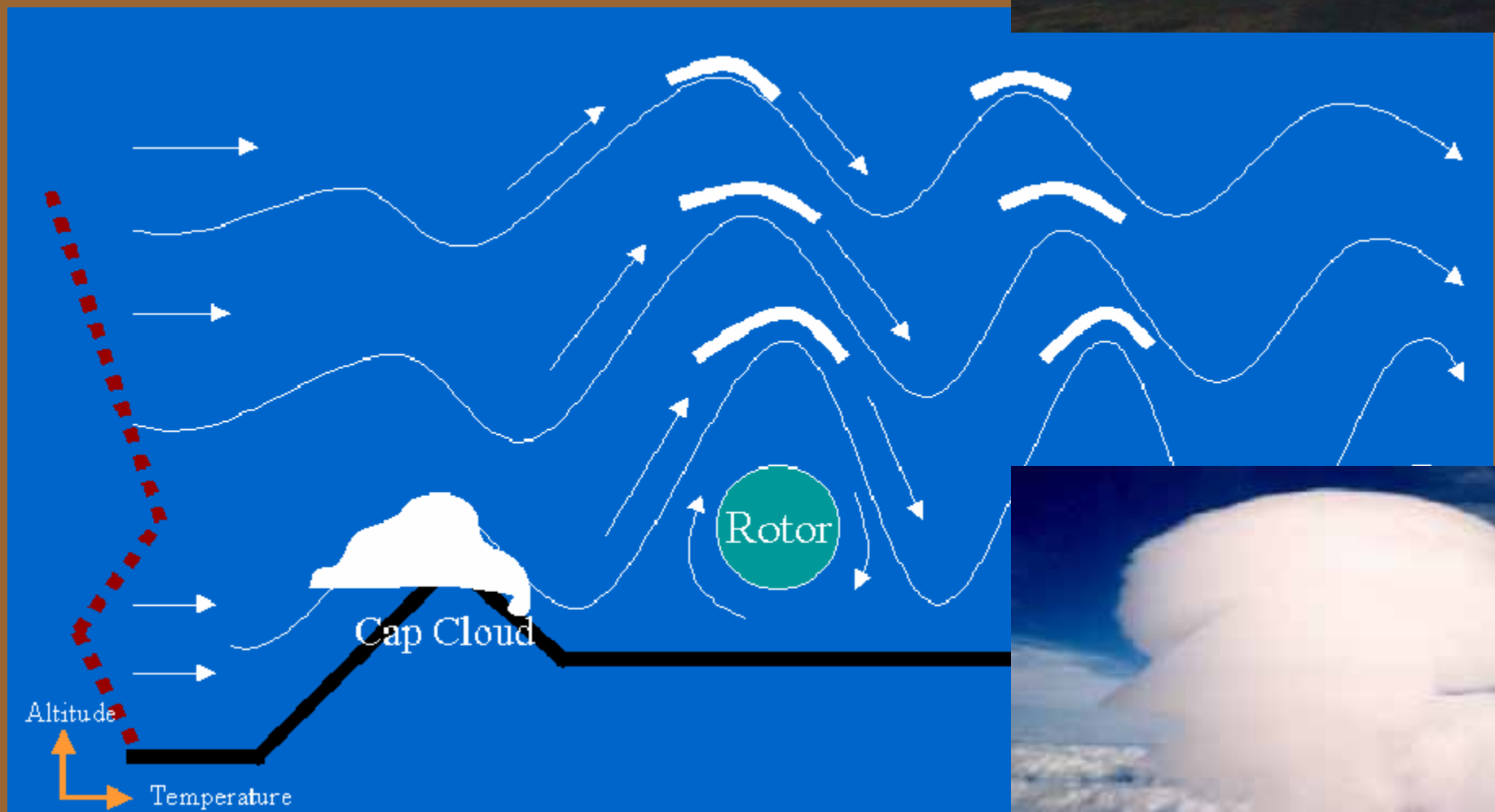
The Drying Process



Mojave Desert Shearlines

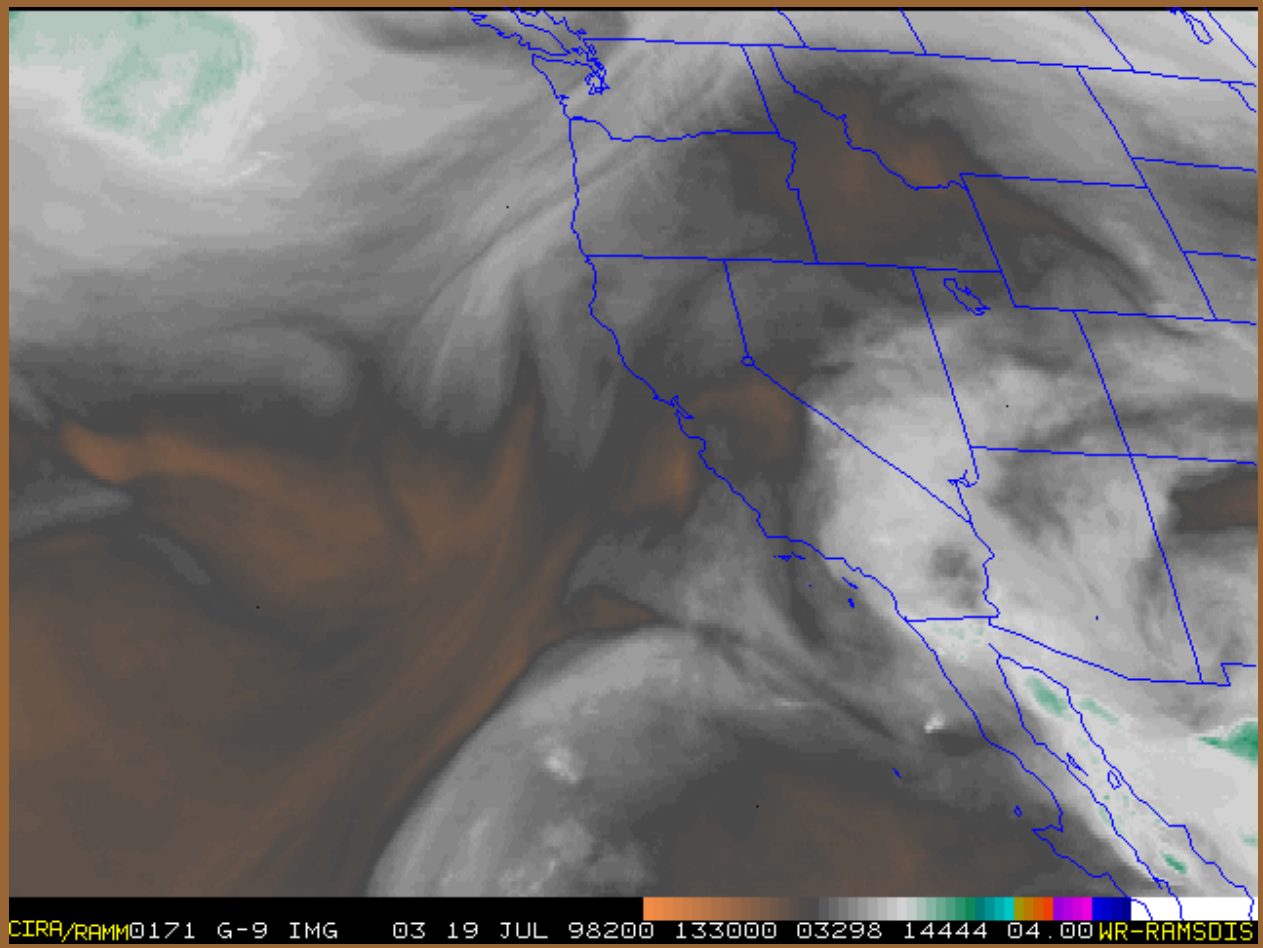


Mountain Wave



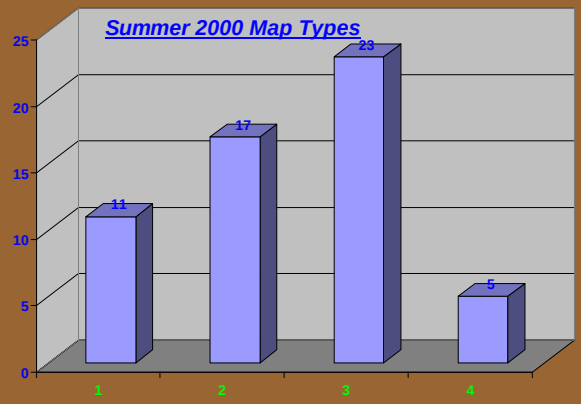
Water Vapor Satellite Imagery

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

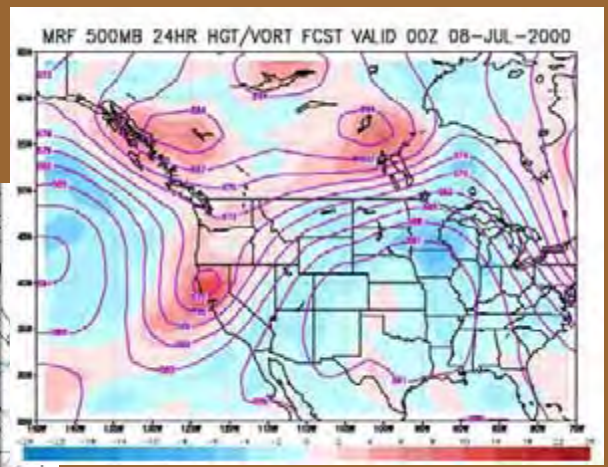


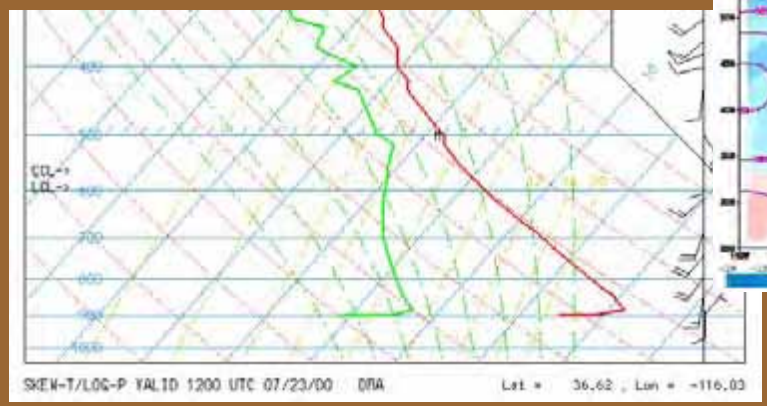
3. Synoptic-Scale Weather Patterns

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



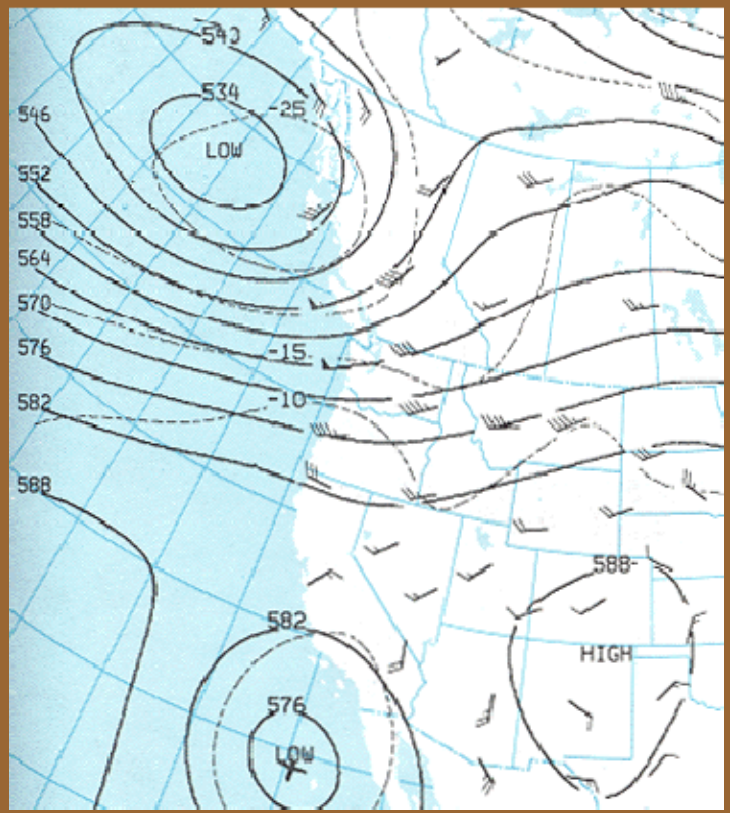


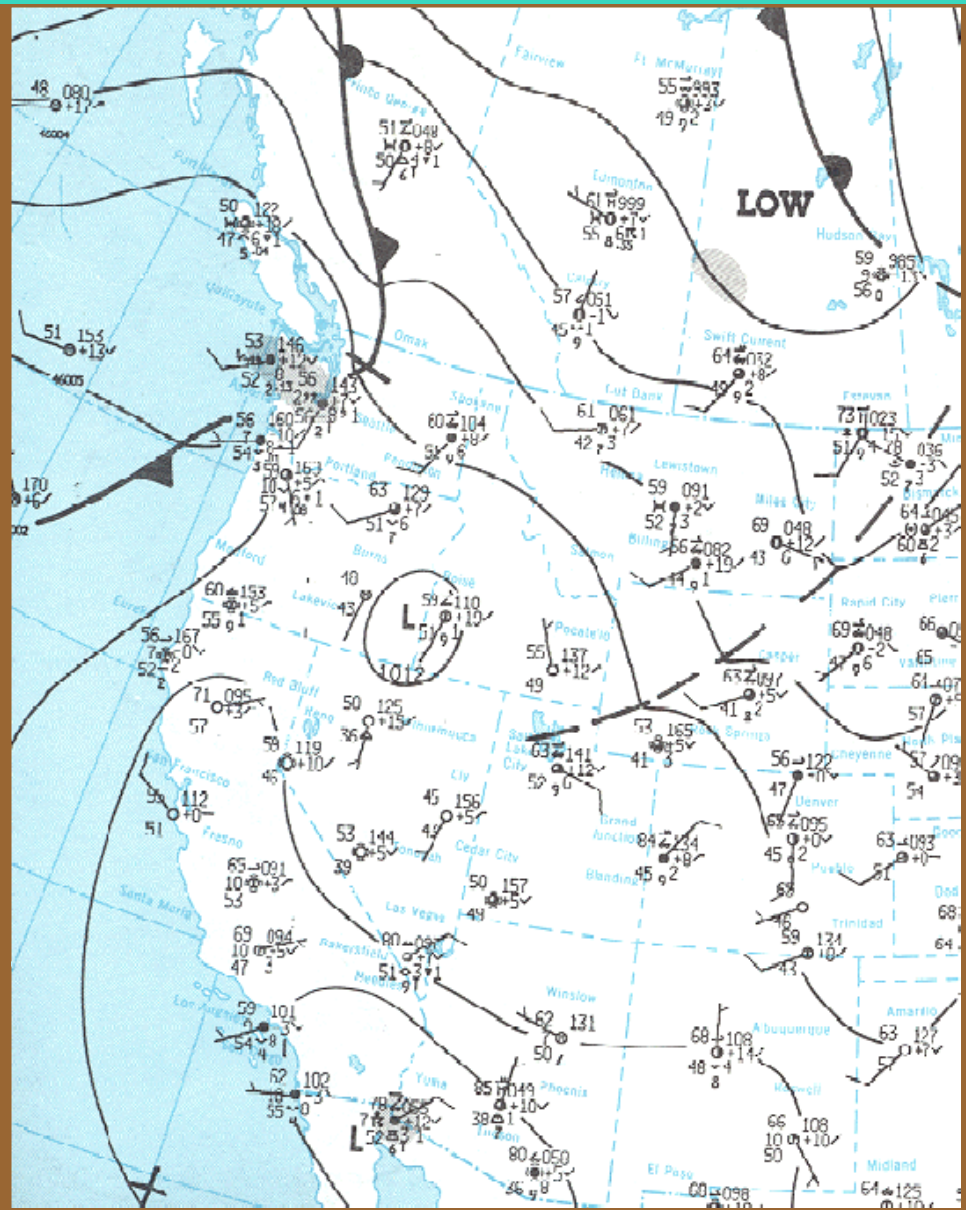
Type #1: The Four-Corner High

- 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

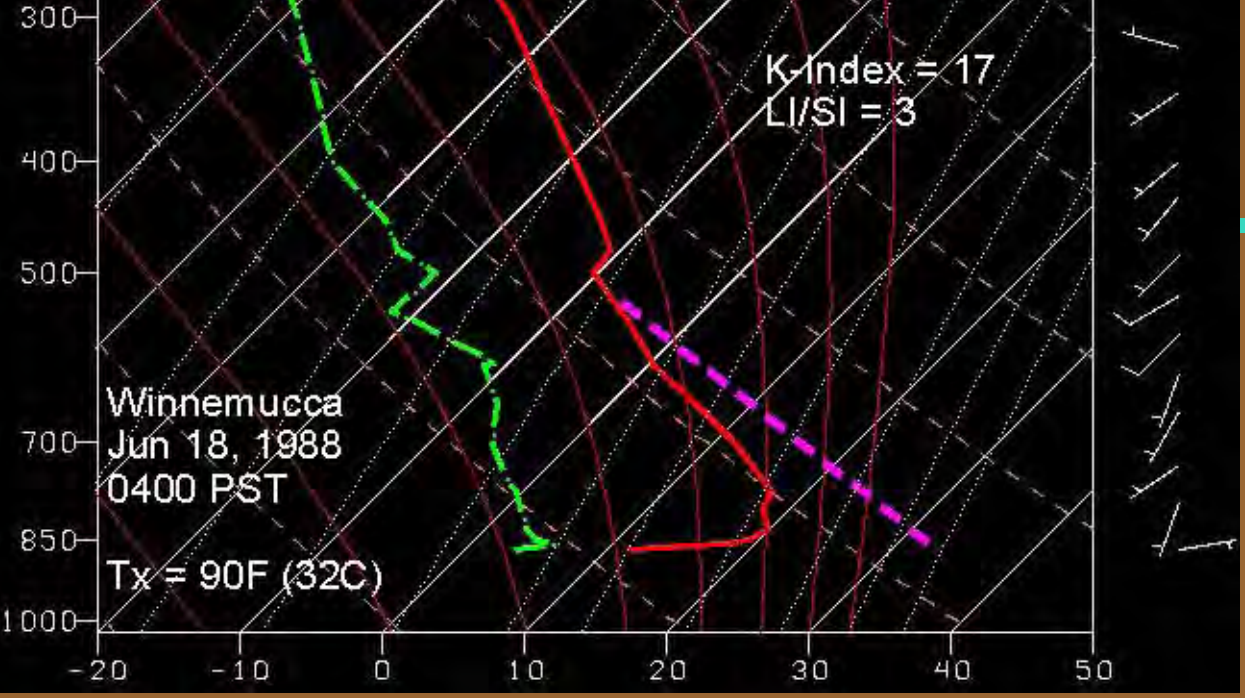
Type #1: 6/18/88

ASI to Keeler and return

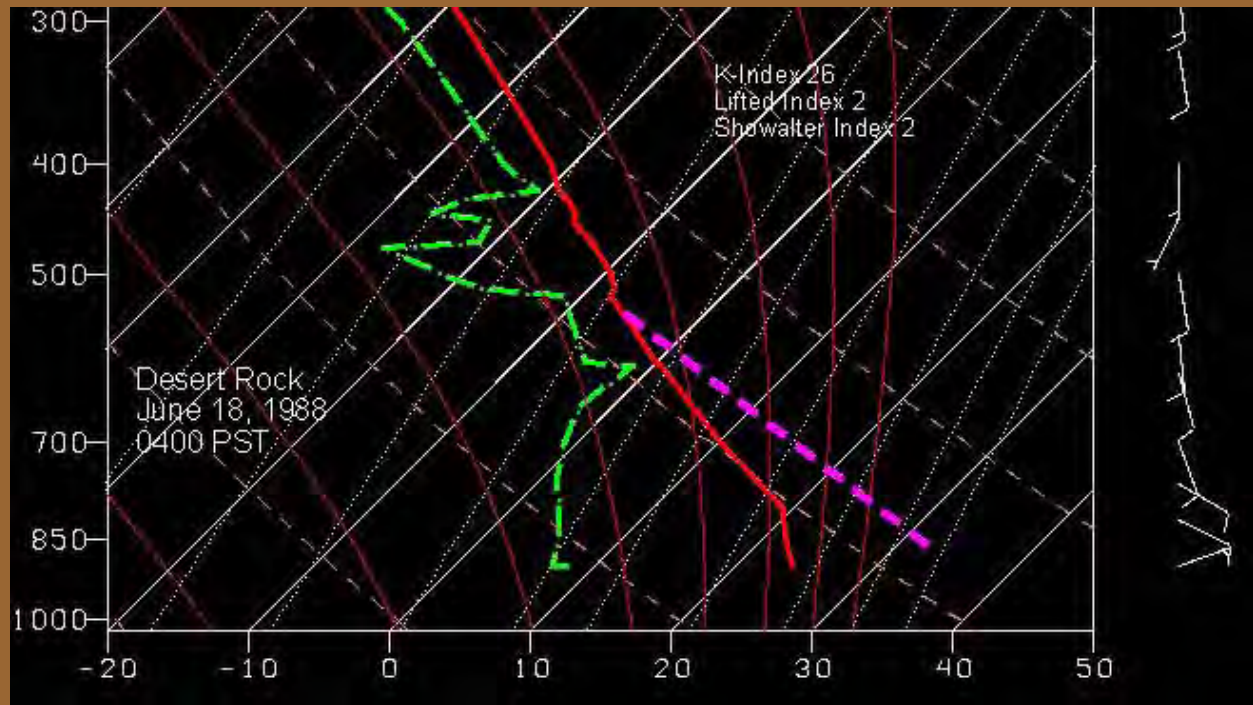




6/18/88 Raobs



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

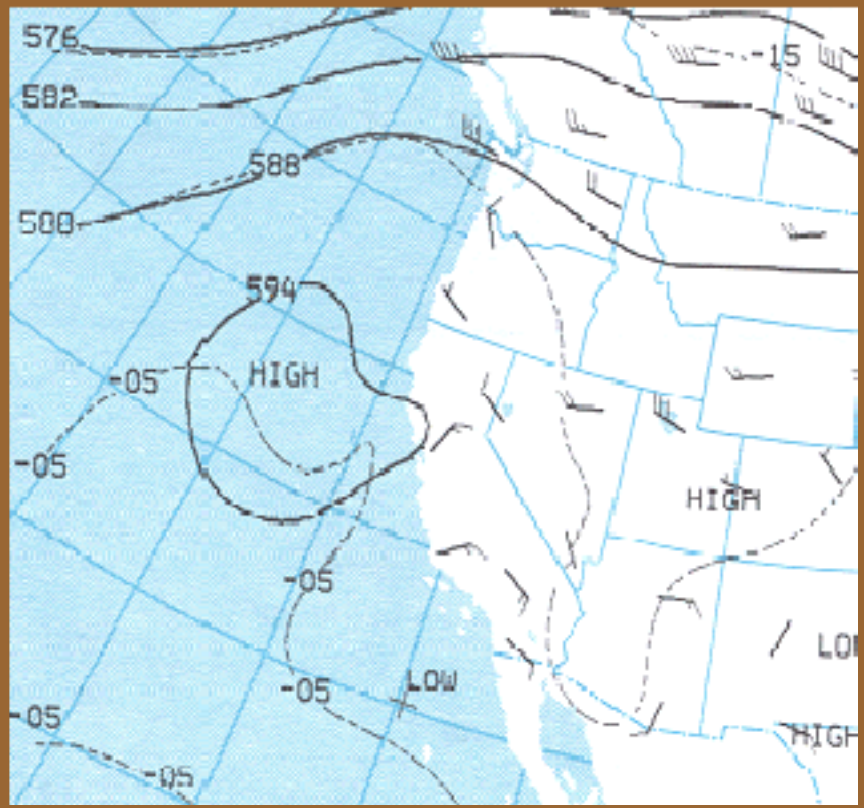


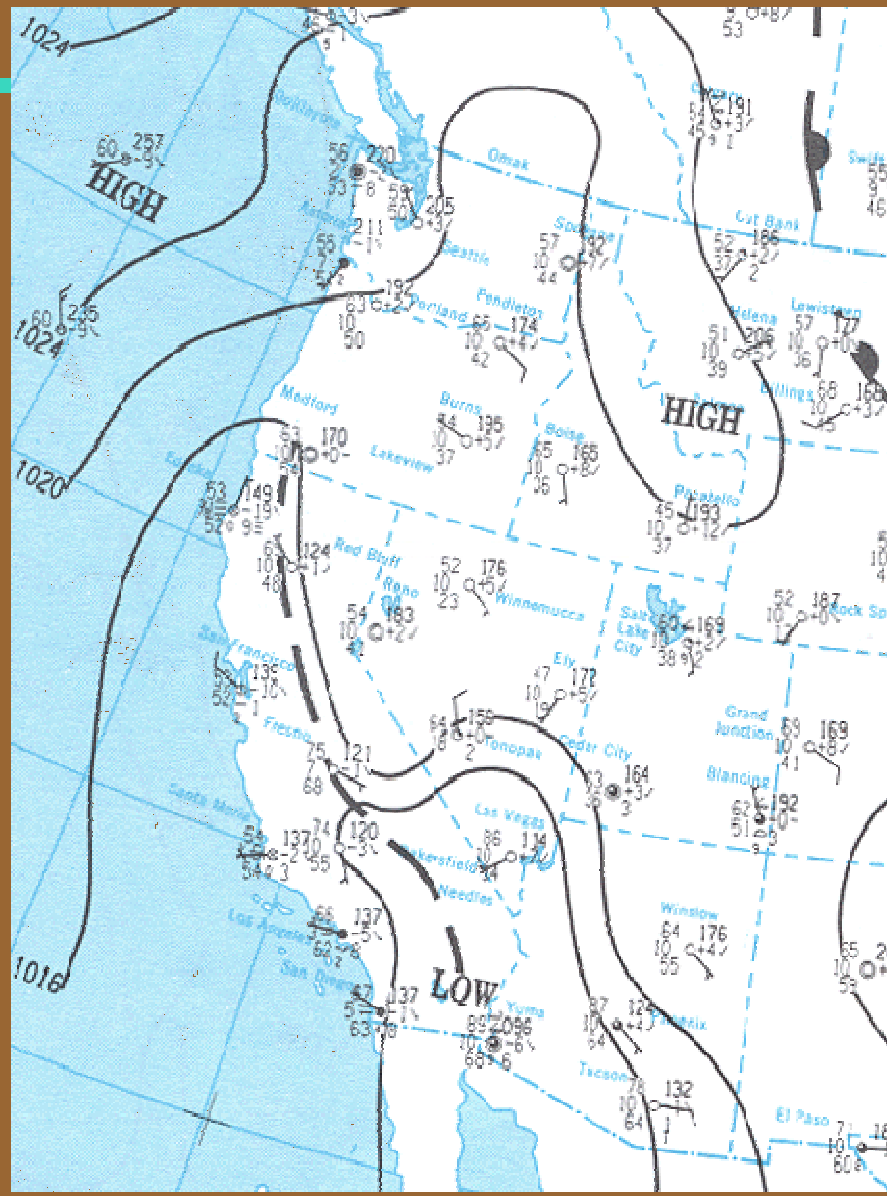
Type #2: Strong Ridge

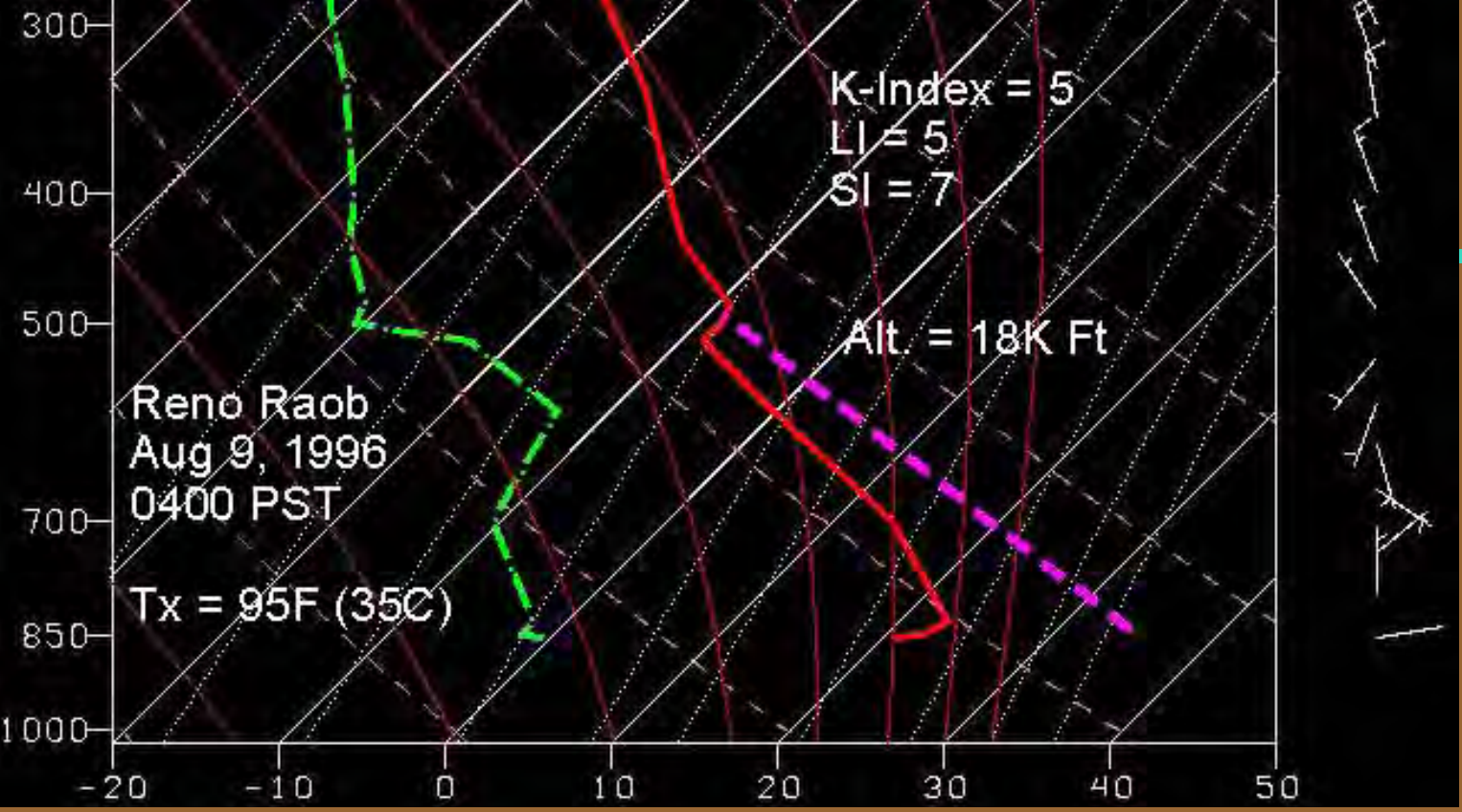
- Light wind
- Low level heating
- Thermal trough well to the west of task area
- Impulse aloft over ridge axis; or,
- Ridge axis aloft east of the task area

Type #2: 8/9/96

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







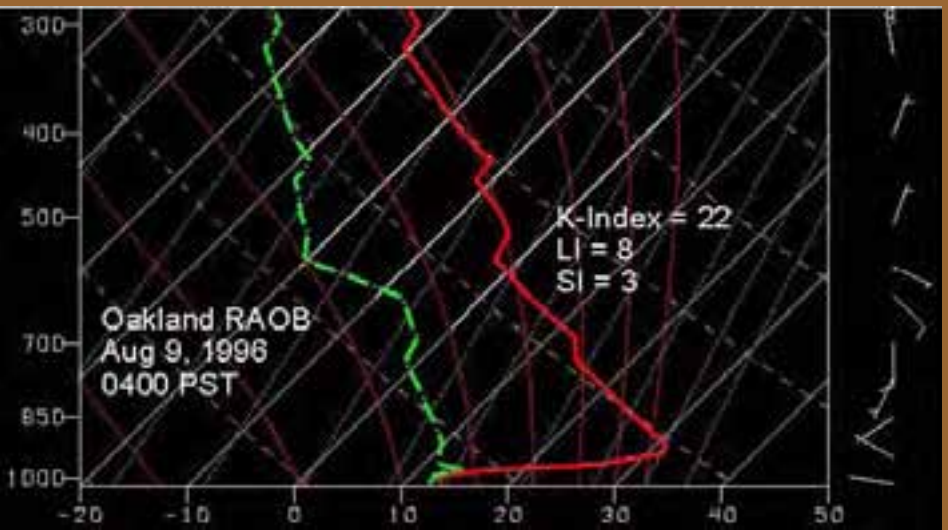
8/9/96

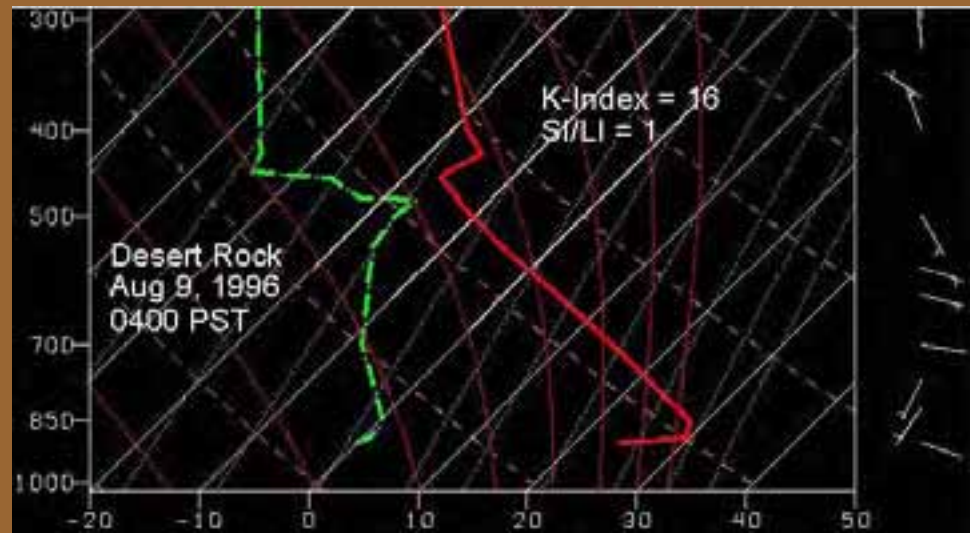
WMC 98/48

RNO 95/53

TPH 95/61

LAS 99/80



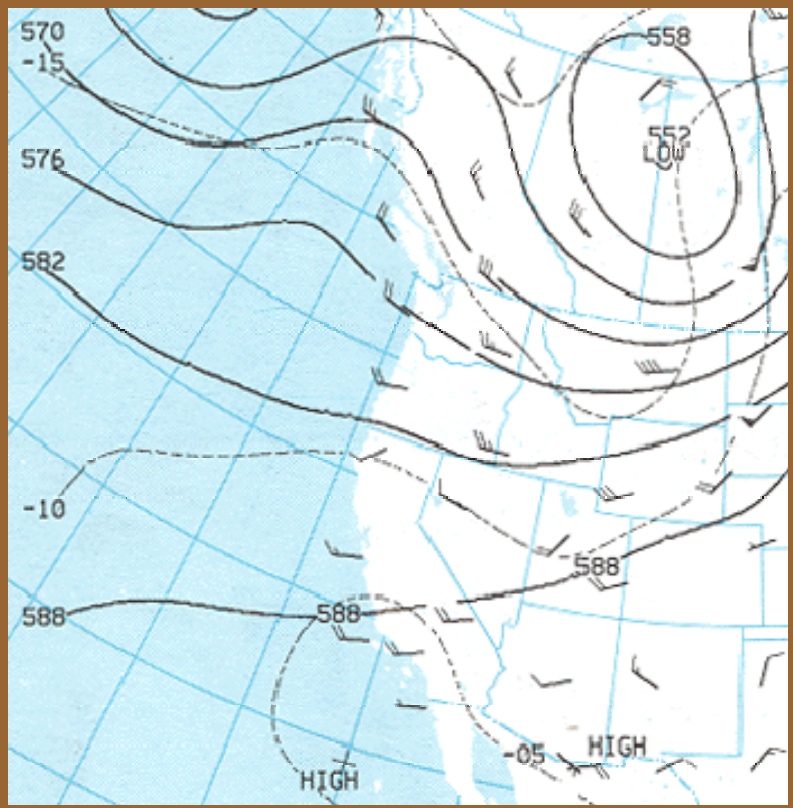


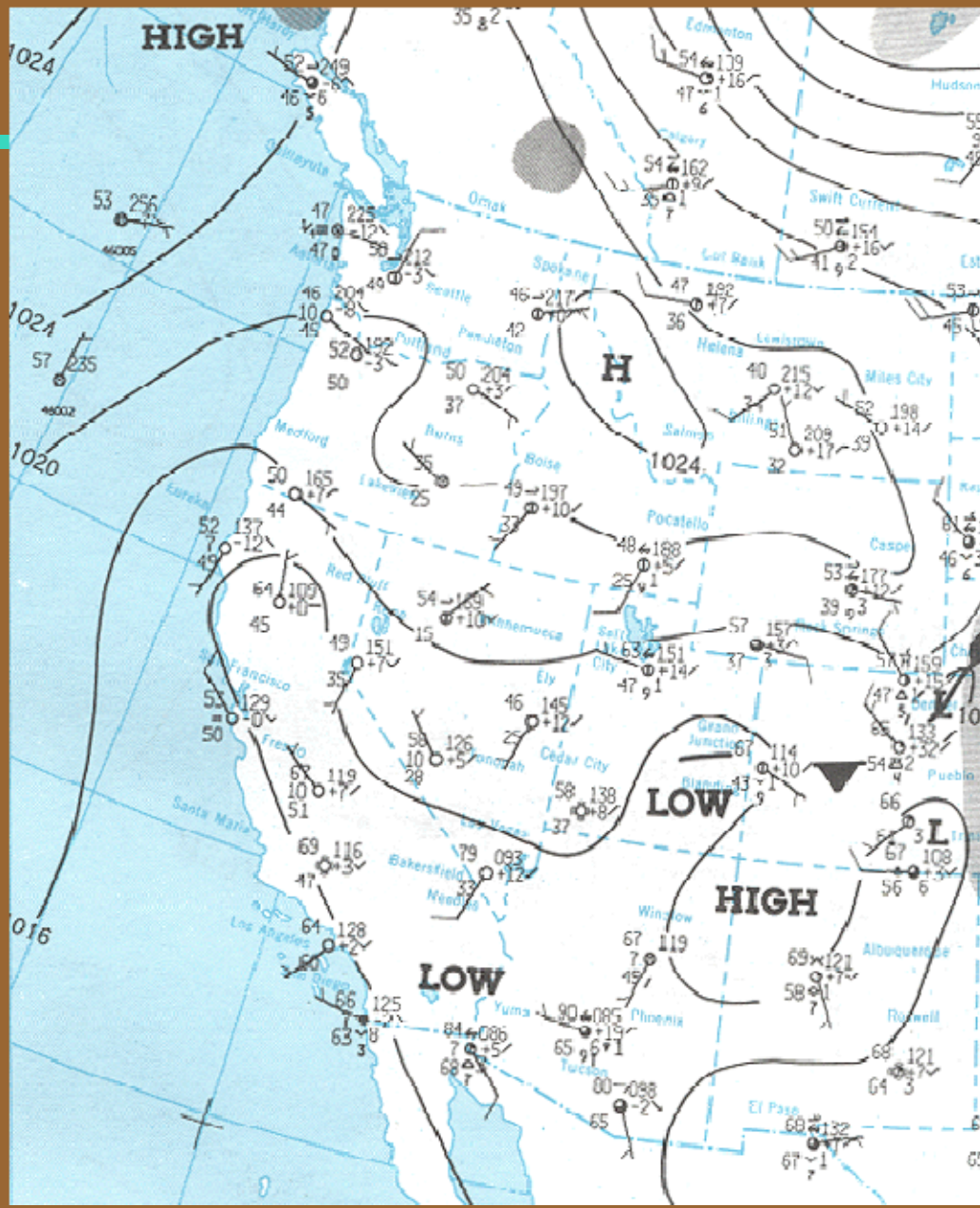
Type #3: Low Center, Trough, or Short Wave Proximity

- 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!

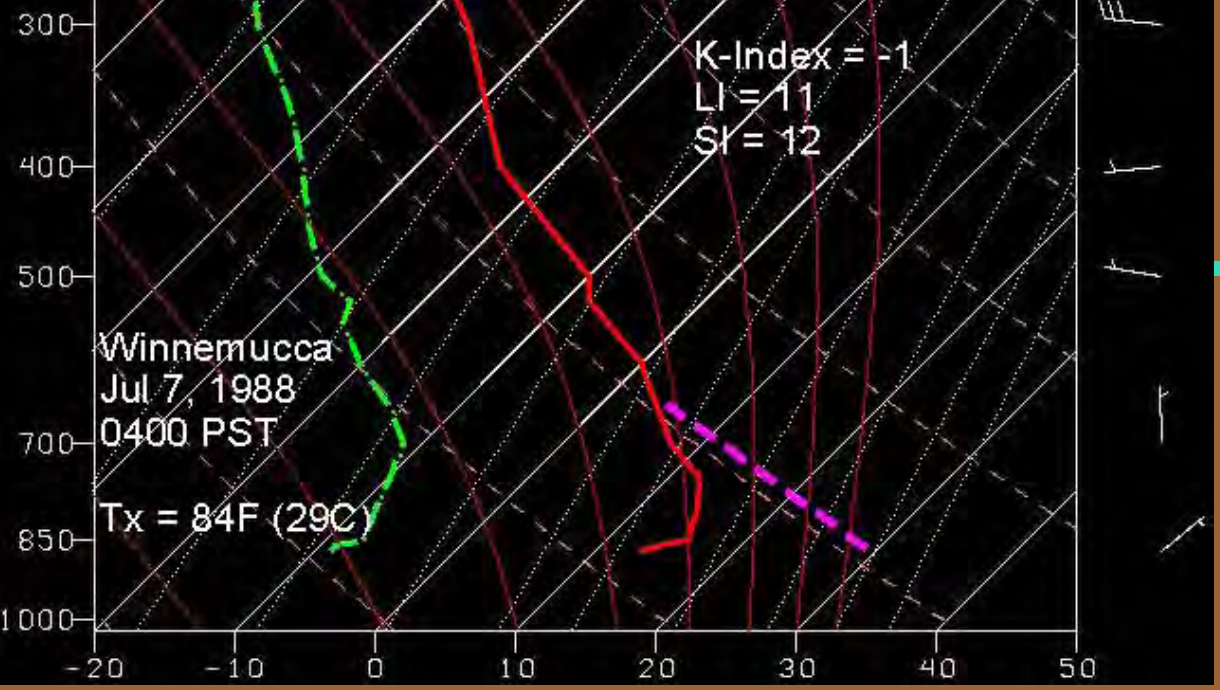
Type #3: 7/7/88

Flight of 350 miles

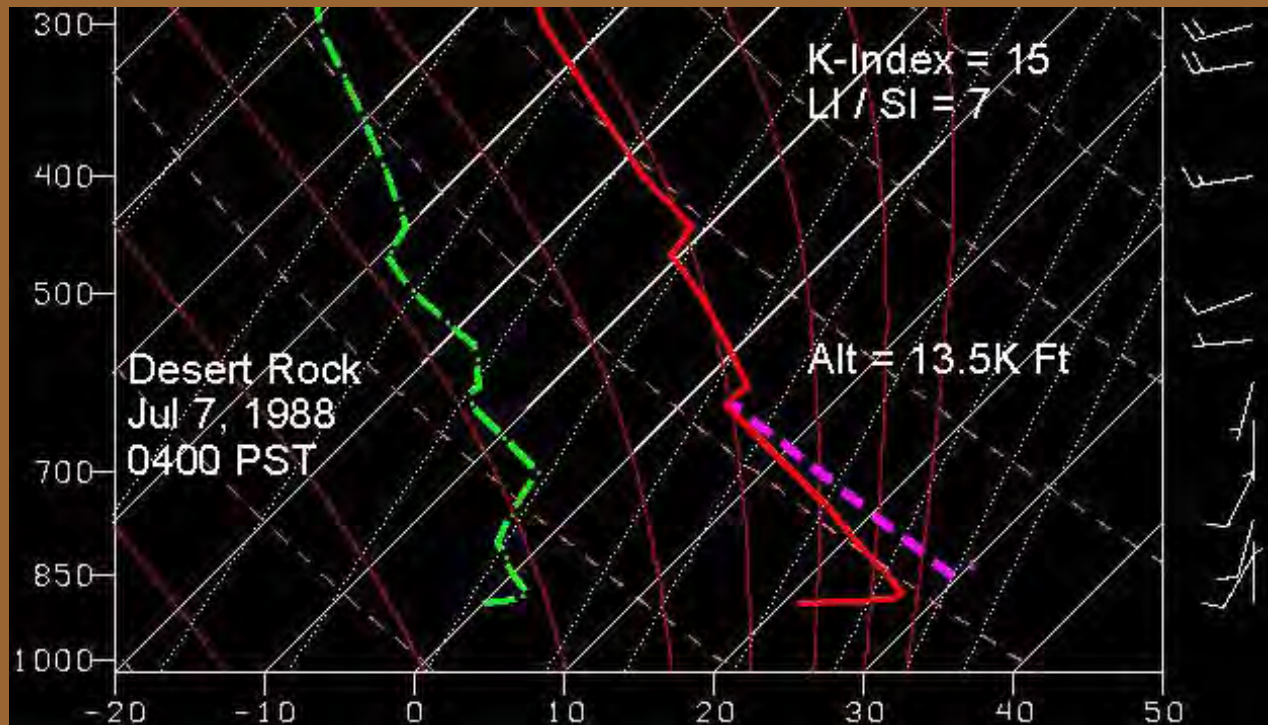




7/7/88 Raobs



- WMC 84/54
- RNO 84/49
- TPH 90/56
- LAS 103/77

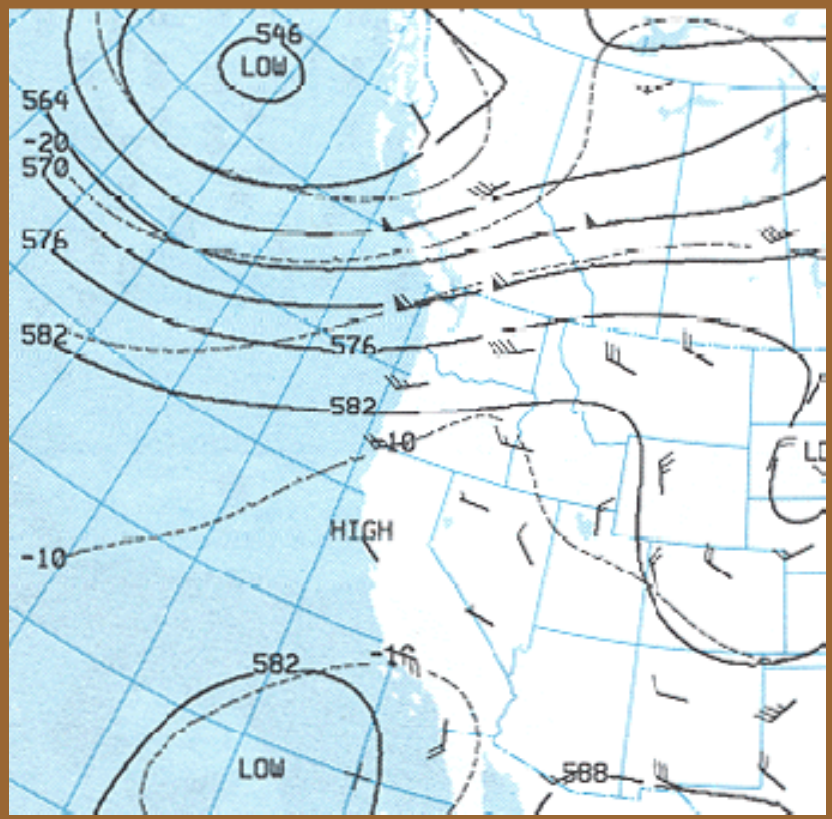


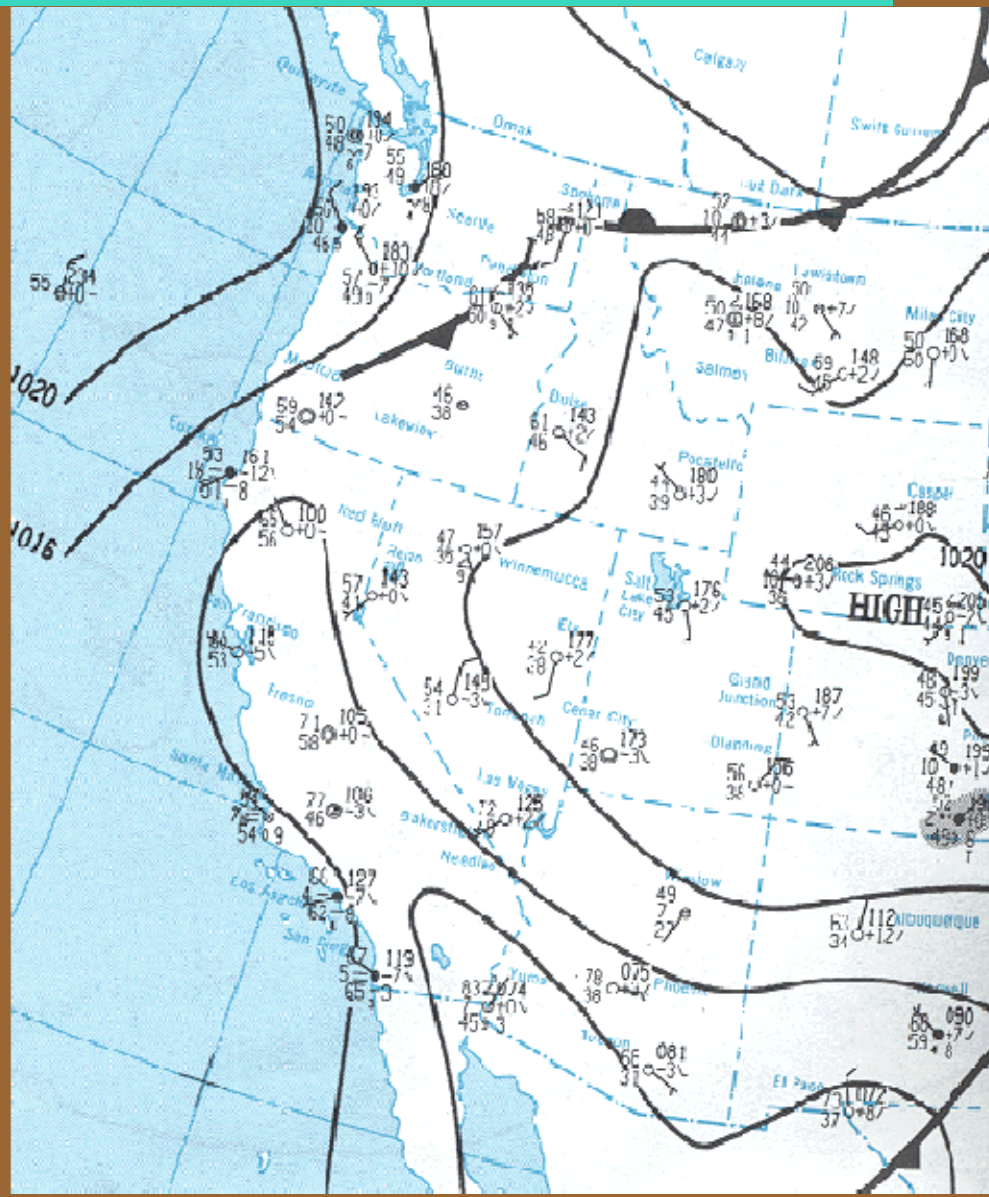
Type #3(a): Proximity of Low Pressure Center

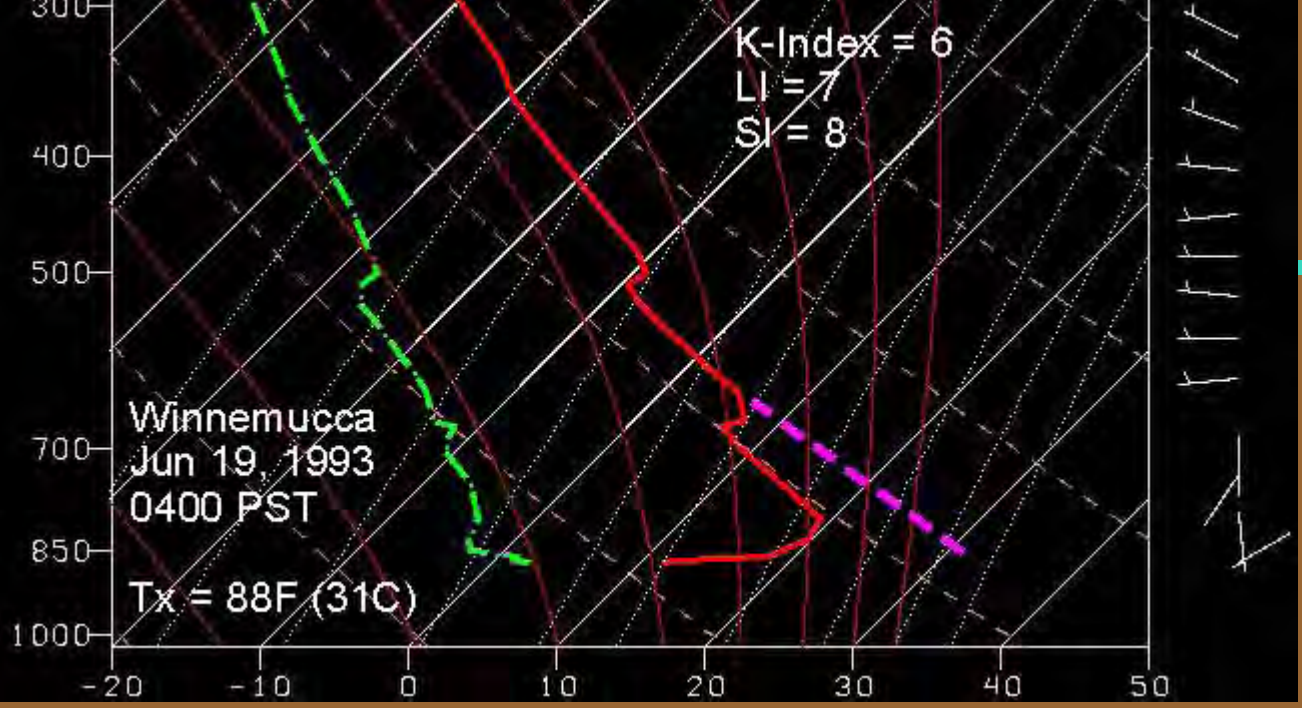
- Low off Southern California coast provides cooler air aloft upstream to de-stabilize
- Elevated heat source influence contributions

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

1000Km flights from Truckee
And Minden area

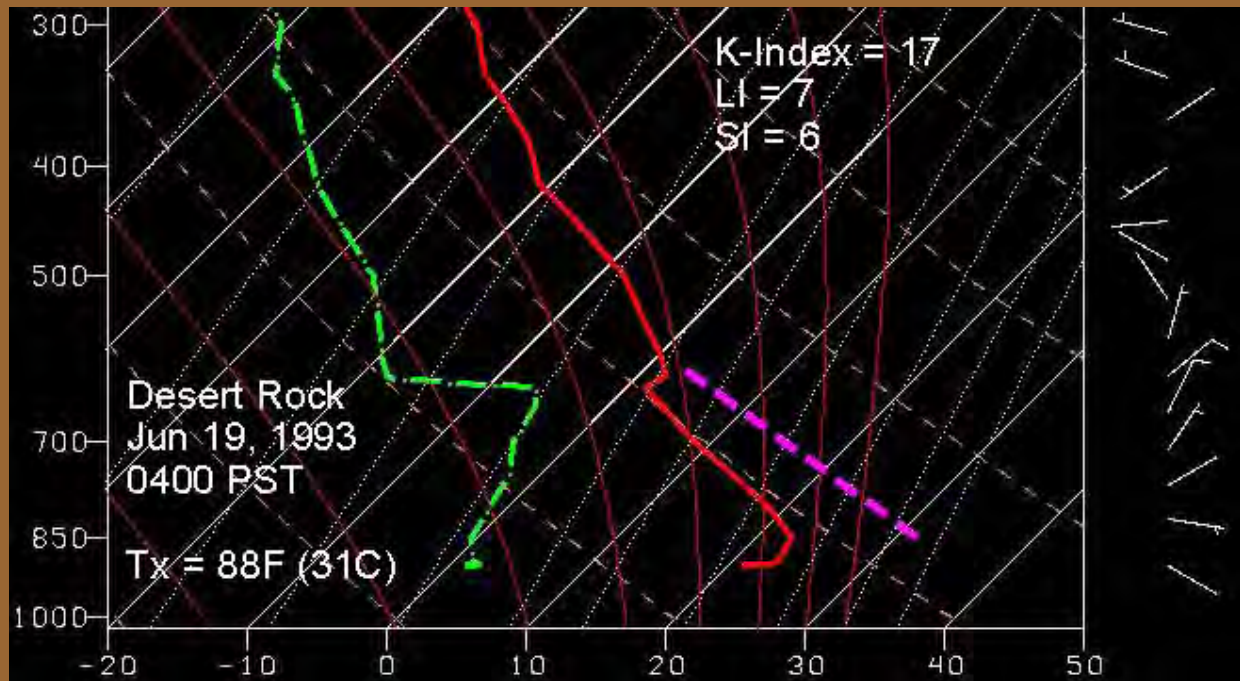






6/19/93 Raobs

- WMC 86/47
- RNO 88/57
- TPH 86/54
- LAS 94/72



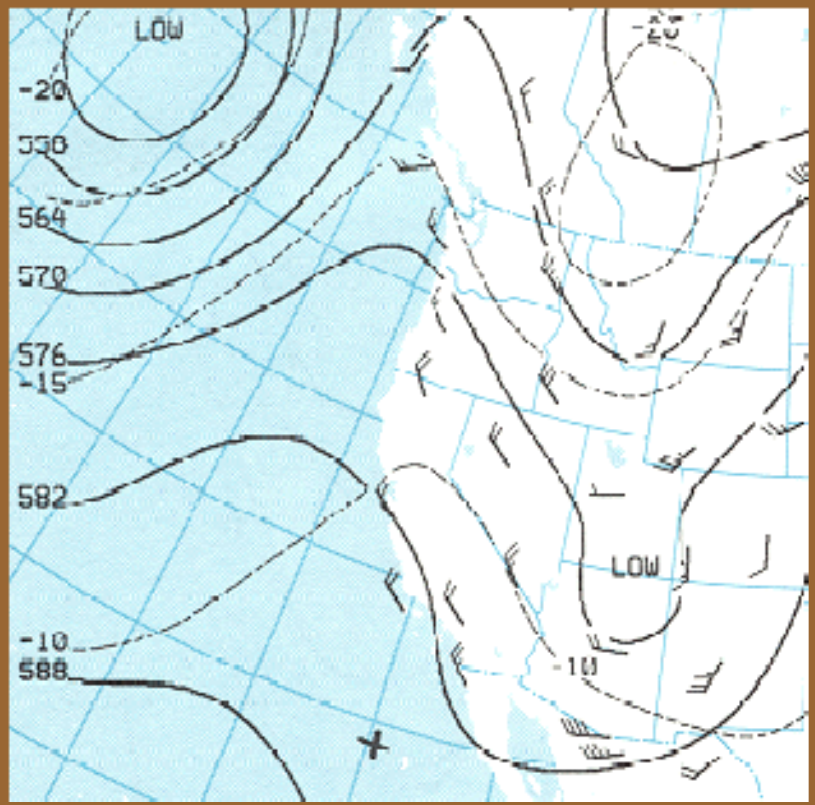
Type #4: Building Ridge Aloft

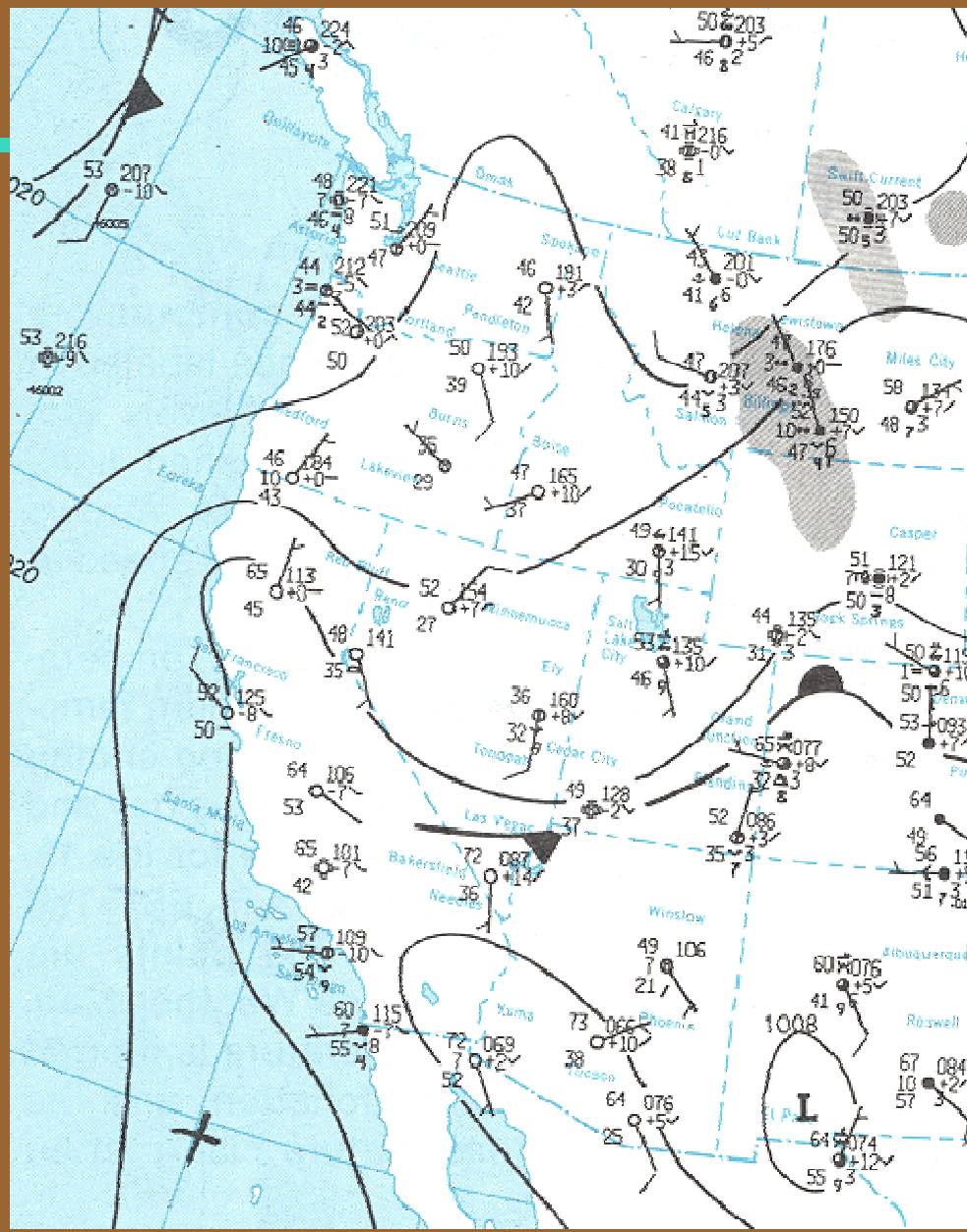
2 Examples / Next 4 Slides

- 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

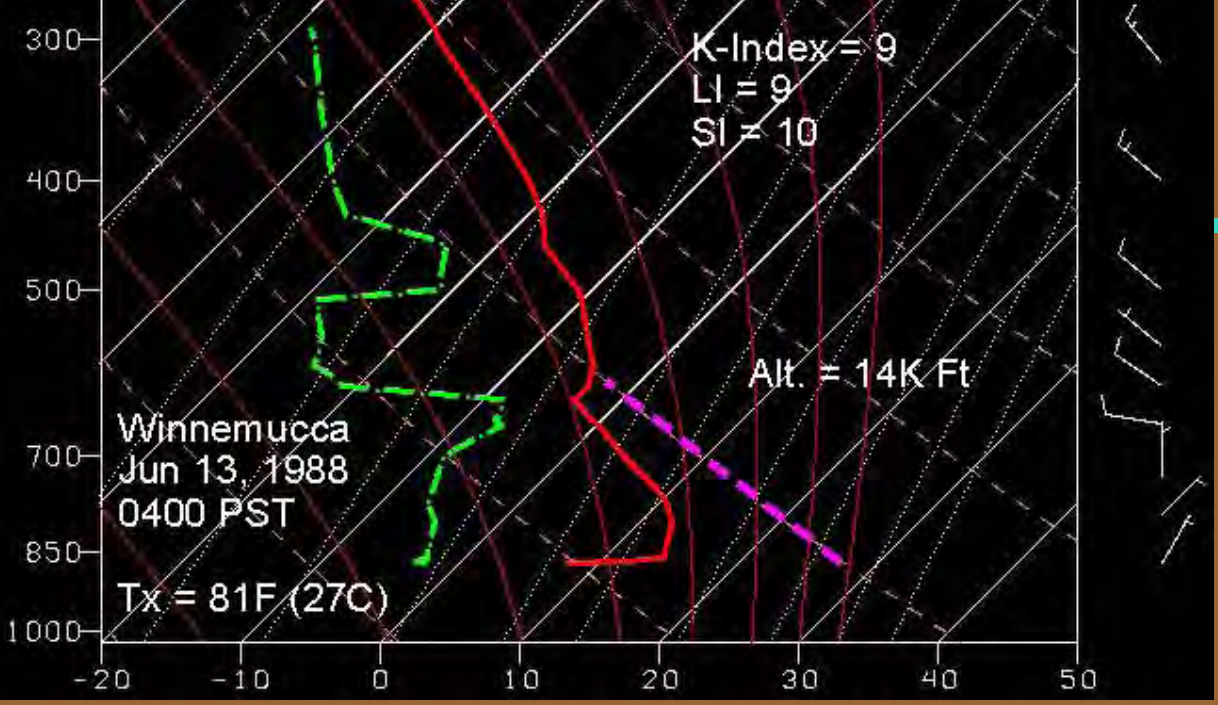
Type #4: 6/13/88

500 Mile Flight

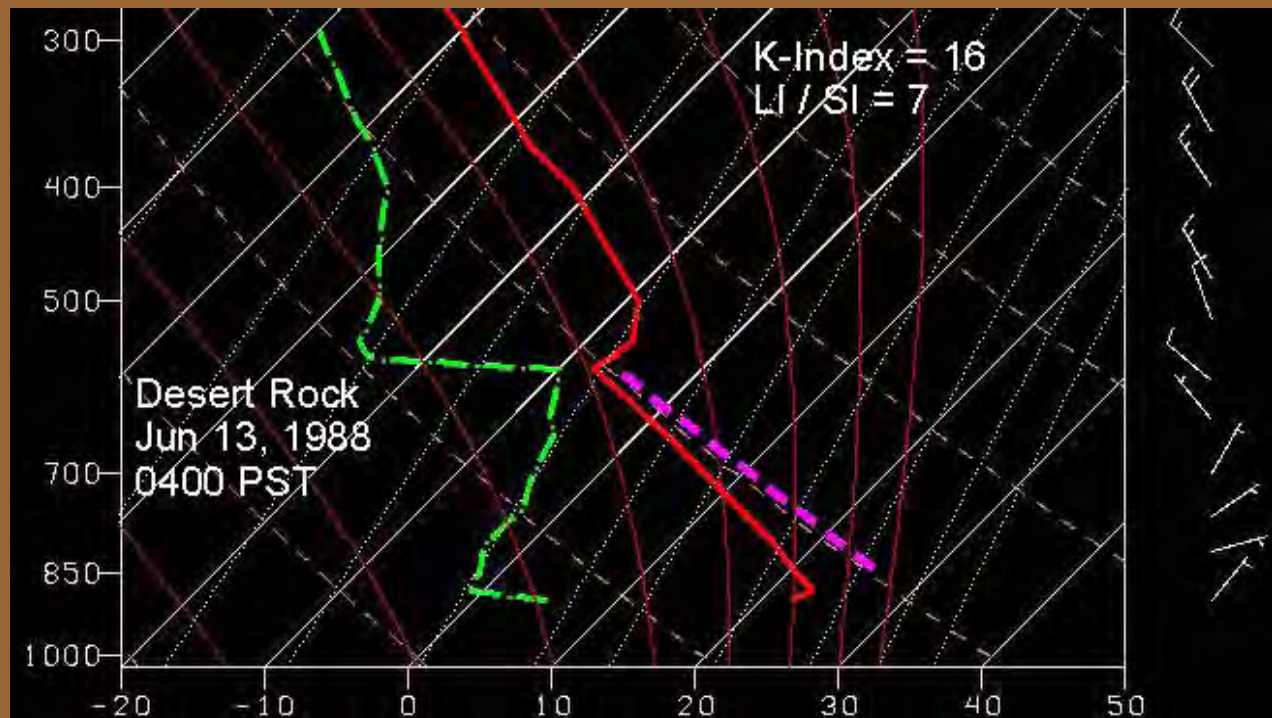




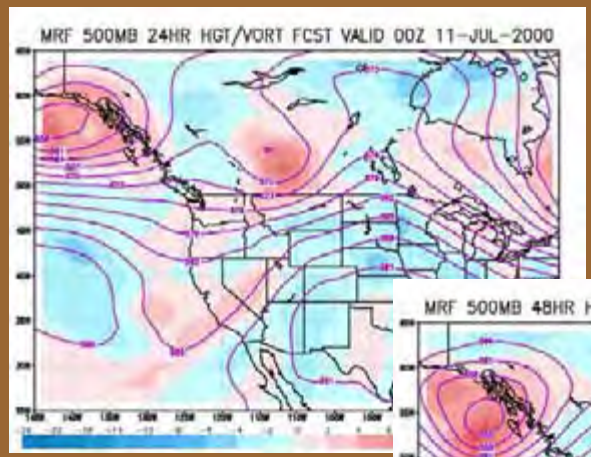
6/13/88 Raobs

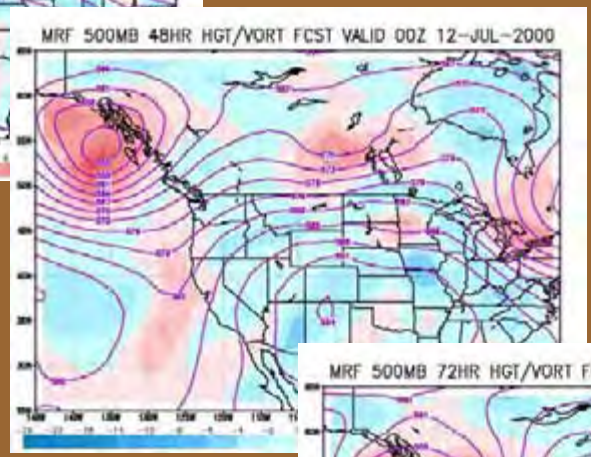


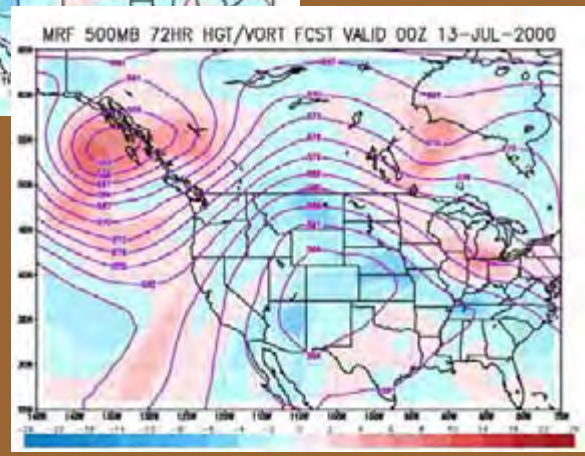
- WMC 81/42
- RNO 81/27 (!!!)
- TPH 78/M
- LAS 95/70



4. Weather Forecasting







- 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)

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(#1)

Great Basin

- K-Index
  - Uses Vertical Totals and 2 fixed reference levels
    - T(C) + 850 dew point(C) - 700 dew point depression(C)
  - 5+ = some cumulus possibilities
  - Thunderstorms increase in the 10-15 range

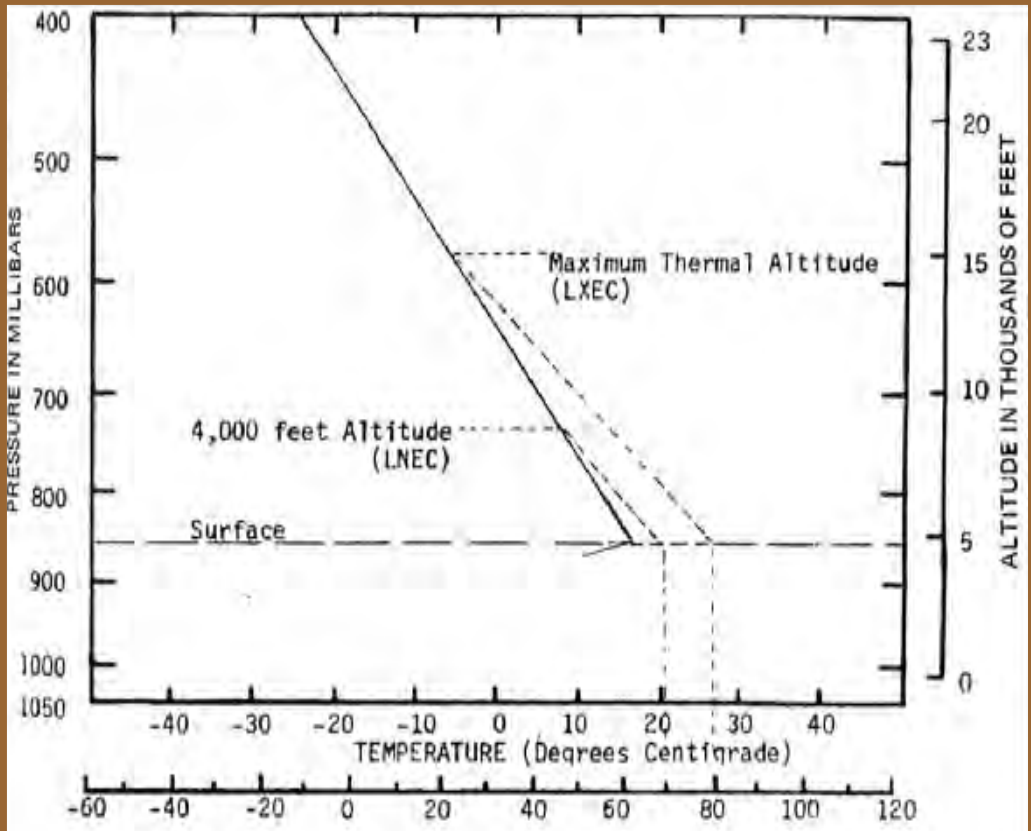
Instability Indices (#2)

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)

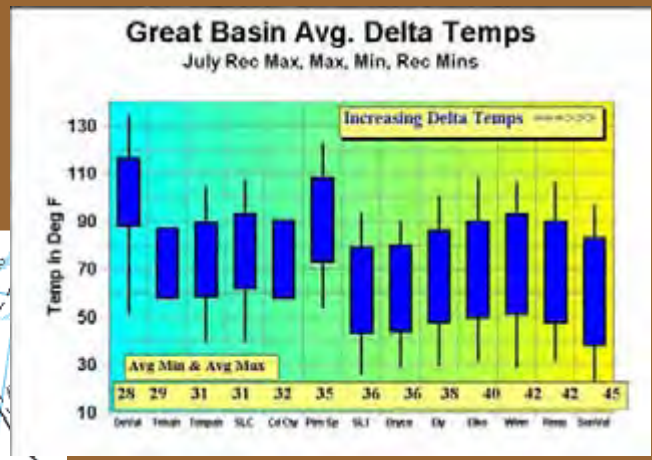


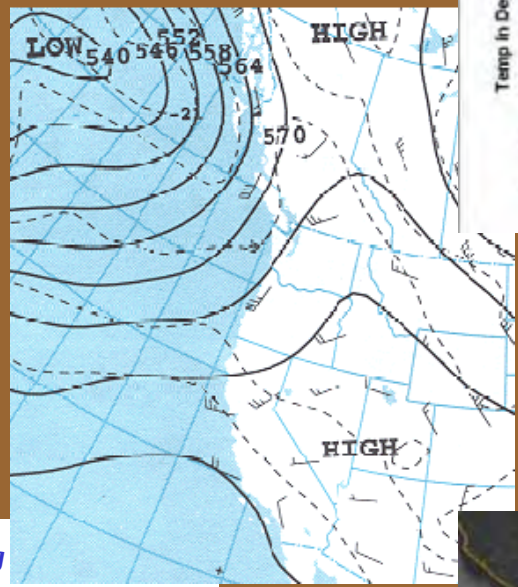
Thermal Fig. 5. The soaring index is computed for the maximum thermal altitude of 15,000 ft and difference of 13° C (LNEC (8° C) minus LXEC (-5° C). In the following formula:

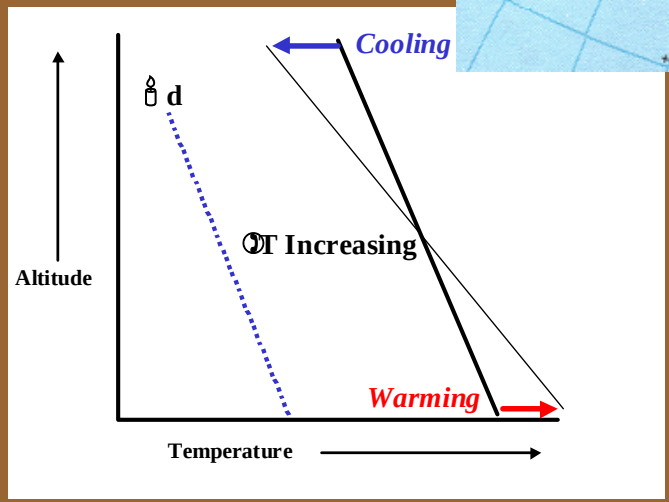
$$\text{Soaring index} = 3\left(\frac{1.5 \times 10^4}{10^2} + 1.3 \times 10^2\right) = 840$$

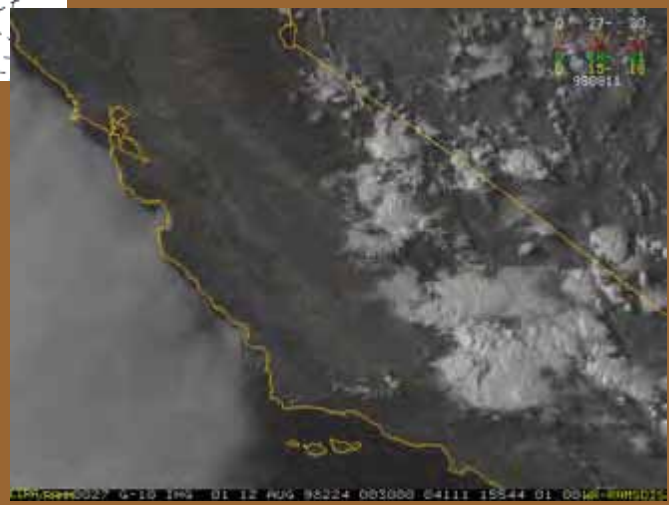
Traditional Soaring Forecasts

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



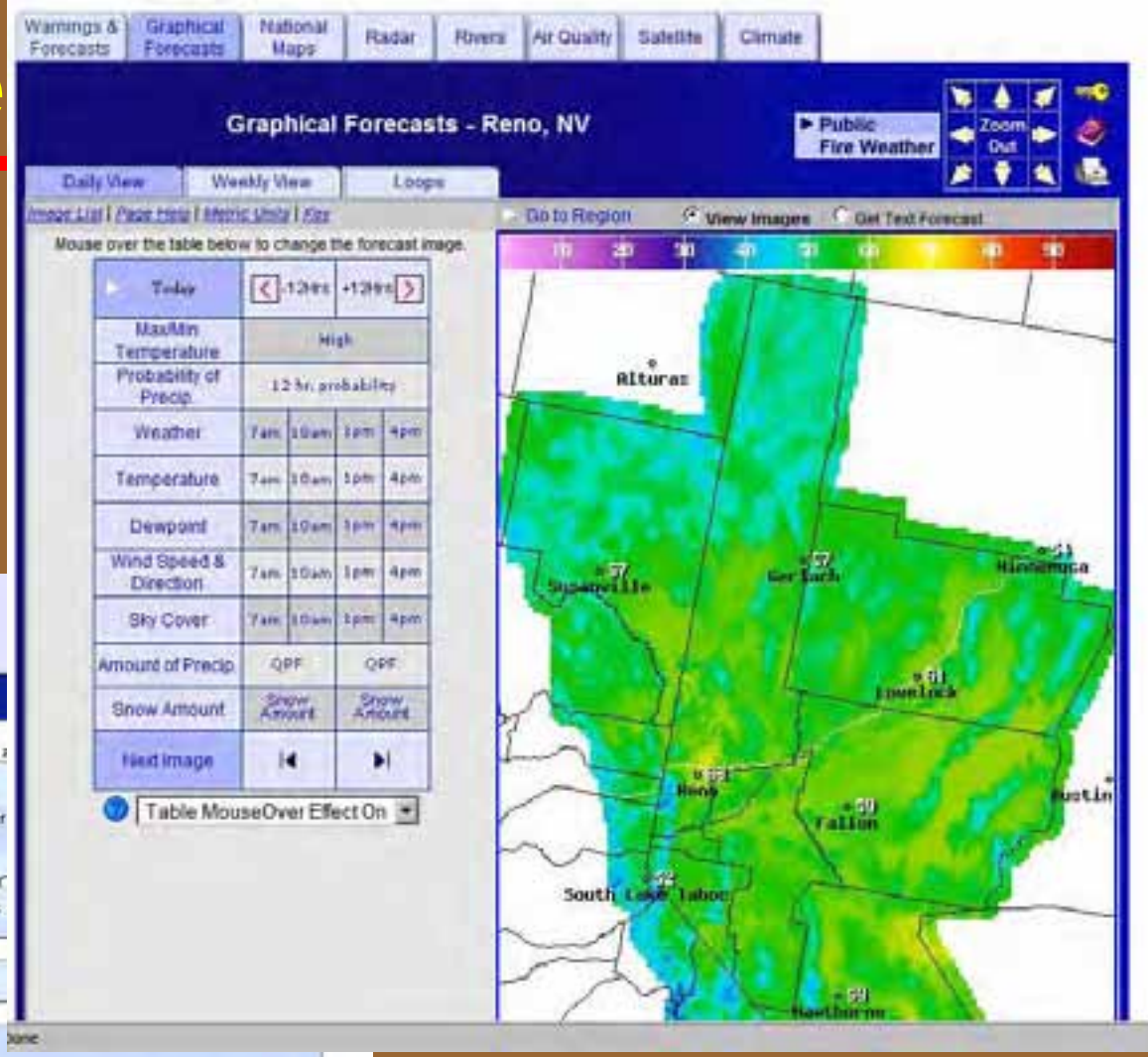






Digital Database

Graphical Display of Requested Weather Parameter(s)



Soaring Weather Forecasting

Dan Gudgel
Meteorologist/Towpilot/CFIG

134 South Olive Street
Lemoore, CA 93245
(w)559-584-3752 ext.223
(h)559-924-7134

<d.gudgel@sbcglobal.net>