Severe Weather Indices/CAPE

Meteorology 3110

Lifted Index

- $LI = T_{500} - T'_{500}$

- Surface parcel
- Recall: Primed values are parcel values

Lifted Index	Stability	Weather
LI > 0	Stable	
LI < 0	Unstable	Significant cumulus convection possible
0 > LI > -4	Marginal instability	usually just showers
-4 > LI > -6	Large instability	Thunderstorms
LI = -7 or less	Extreme instability	Severe Thunderstorms

Showalter Index

- $SI = T_{500} – T'_{500}$

- Parcel lifted from 850 hPa.

Showalter Index	Stability	Weather
SI > 3	Stable	
SI < 3	Unstable	Possible showers
1 > SI > -2	Marginal instability	Thunderstorms likely
SI < -3	Large instability	Thunderstorms

SI Compared to LI

- If the LI is negative while the SI is positive (such as shown in sounding below), that is an indication that the PBL is unstable while the region just above the PBL is stable (some capping exists).

- If the LI is positive while the SI is negative, that is an indication that the PBL is stable but the lower troposphere becomes unstable with height. This can occur in cases where shallow polar air is in the PBL while there is an unstable air mass aloft.

- If the LI and SI are both negative it often indicates a deep layer of unstable air in the lower troposphere is in place.

- If the LI and SI are both positive it often indicates a deep layer of stable air in the lower troposphere is in place.

K Index

- $K = T_{850} + T_{d\ 850} - T_{500} – (T_{700} - T_{d\ 700})$
- Uses only environmental temperature
- K > 30 usually associated with thunderstorms

K Index	Potential
15 - 25	Small convective potential
26 - 39	Moderate convective potential
40 +	High convective potential

Total Totals

- $TT = T_{850} + T_{d\ 850} - 2 \times T_{500}$
- Uses only environmental temperature
- $TT > 50$ usually indicates severe storm potential

TT Index	Potential
< 44	Convection not likely
44 - 50	Likely thunderstorms
51 - 52	Isolated severe storms
53 - 56	Widely scattered severe storms
>56	Scatter severe storms

SWEAT Index

- SWEAT = (12 x T_{850}) + 20 x (TT – 49) + (2 x V_{850}) + V_{500} + 125 x (sin(dd_{500} – dd_{850}) + 0.2) where:
- V = wind speed at level
- dd = wind direction at level

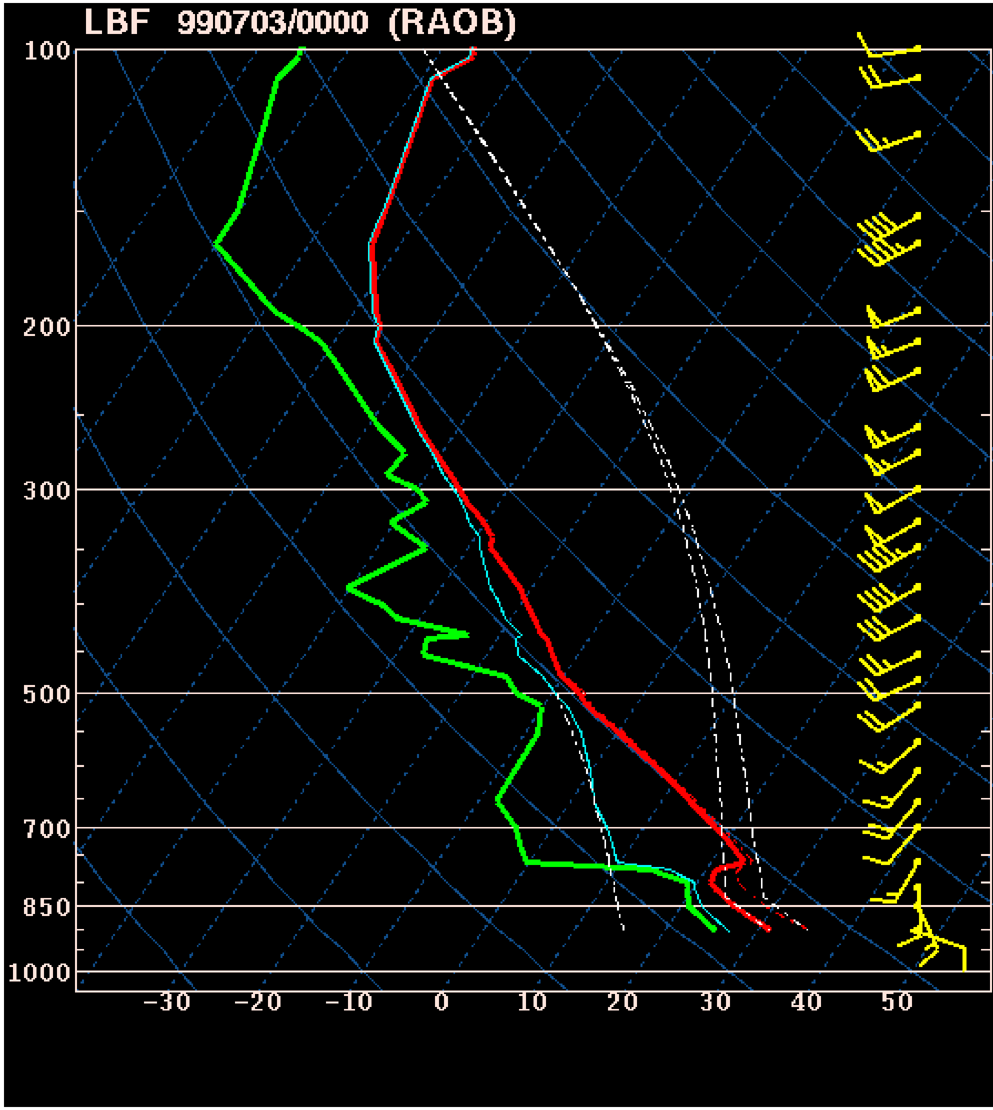
- SWEAT > 250 usually indicates potential for strong convection.

SWEAT Index	Potential
150 - 300	Slight severe
300 - 400	Severe possible
400 +	Tornadic possible

CAPE

- Convective Available Potential Energy
- Integrated temperature difference over depth of the atmosphere
- What if all CAPE is converted to KE? How strong could updrafts be?

CAPE (J/kg)	Potential
500 - 1500	Weak
1500 - 2500	Moderate
2500 - 4000	Strong
> 4000	Extreme



CURSOR			SOUNDING	
348mb	8576m	θ=372.9K	347mb	8589m
2.6C	28129ft	θw=308.1K	-27.5C	
36.6F	13.5g/kg	θe=422.2K	-34.5C	240/45 kt t

PARCEL DATA

*** MU PARCEL IN LOWEST 300mb ***

LPL: 906mb 31C / 25C 88F / 78F

CAPE = 9485 J/Kg LI (500mb) = -17 C
BFZL = 639 J/Kg LImin = -26C / 224mb
CINH = 0 J/Kg Cap = 0C / 811mb

LEVEL	PRES	HGT(AGL)	TEMP
LCL	831mb	2517ft	
LFC	831mb	2517ft	24C
EL	103mb	50940ft	-66C
MPL	M	M	

THERMODYNAMIC DATA

------- AVAILABLE MOISTURE -------

P. Water = 1.47 in Mean RH = 35 %
Mean W = 19.8 g/Kg Mean LRH = 59 %
Top of Moist Lyr = 802 mb / 3526 ft

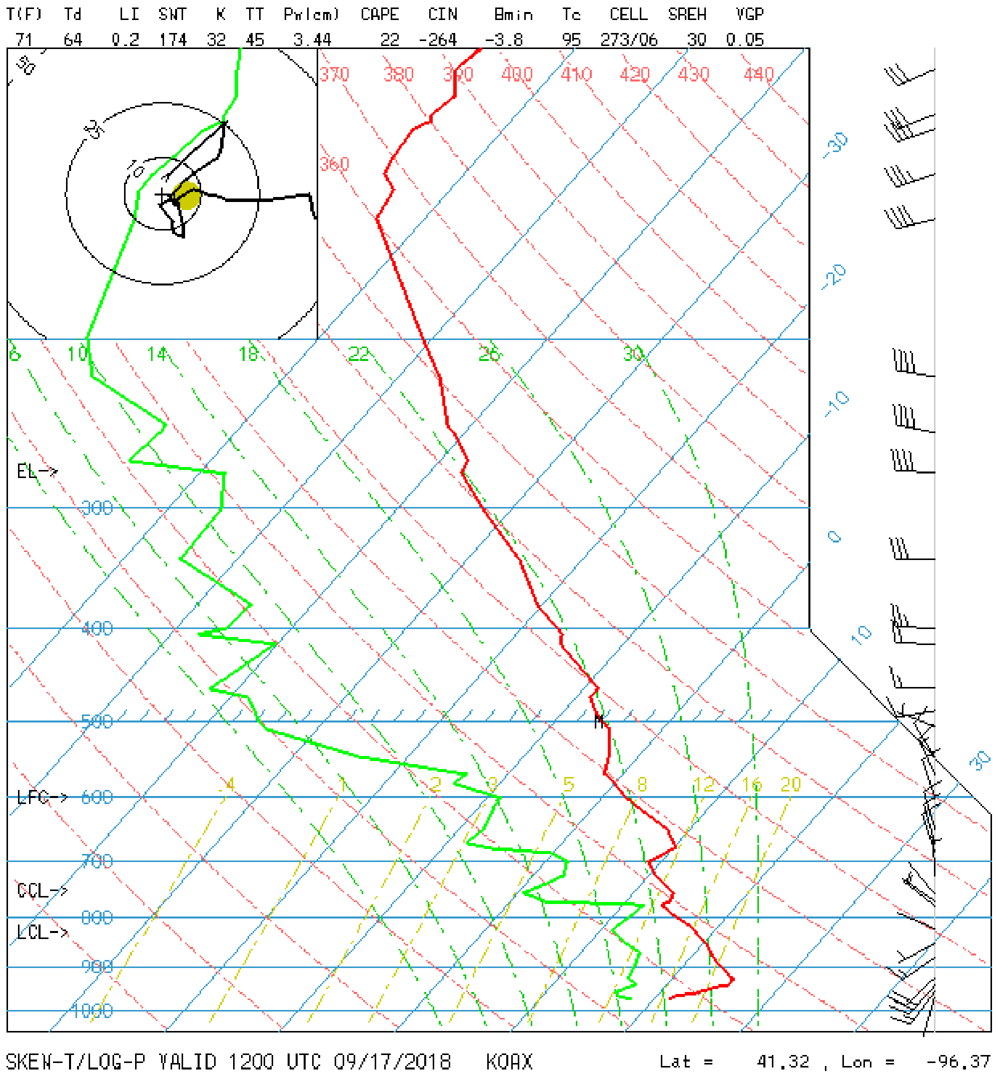
------ CONDITIONAL INSTABILITY ------

700-500mb Lapse Rate = 25 C / 9.2 C/km
850-500mb Lapse Rate = 36 C / 8.0 C/km

------ MISC PARAMETERS ------

Total Totals = 60 K-Index = 32
SWEAT Index = 678 Max Temp = 93F
ThetaE Diff = 52C Conv Temp = 89F
WBZ level = 11170ft FGZ level = 13920ft

How about today in Omaha, NE?



Factors that Impact CAPE

- Water Loading
  - The presence of high density liquid water in the updraft.

- Entrainment
  - The mixing of dry, cool environmental air into the updraft

Fat CAPE vs. Skinny CAPE

- Which profile will result in stronger updrafts? Why?

- NCAPE – Normalized CAPE
  – CAPE/Depth of Buoyant layer
  – Tall, skinny CAPE ~ 0.1
  – Fat CAPE ~ 0.3 – 0.4

Dry Mid-Levels → Strong Downdrafts

- Reduces buoyancy (cooling)

- Strengthens downdrafts. Why?

- Weakens updrafts

- DCAPE
  - Larger values, stronger downdrafts

CIN – Convective Inhibition

- Prevents parcels from reaching LFC.
- Additional mechanism need to initiate convection. What mechanisms are useful?
- Heating
- Moistening (low level advection, evaporation)
- Lifting (synoptic scale)