PACIFIC REGION TECHNICAL NOTES

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NOTES ON STABILITY INDICES

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INTRODUCTION

1. Many indices available
   - more than a dozen commonly used
2. Developed for quick analysis of the buoyancy potential of the atmosphere
3. Indices basically look at the temperature profile;
   - some relate temp profile with low and mid-level moisture distribution
4. All indices are primarily concerned with sfc or low-level based thermo convection
5. Things not considered are dynamic effects such as lift due to hills and mountains, convergence zones, vorticity, fronts
6. Indices do not directly consider effects of latent heat

Some of the More Common Indices

1.	Gardner-Scherhag index	(1949)
2.	Showalter index	(1953)
3.	Lifted index	(Galway 1956)
4.	K-index	(George 1960)
5.	Delta thickness index	(Jenrette 1960)
6.	Rockcliff index	(1962)
7.	Jefferson index	(1963)
8.	Boyden index	(1963)
9.	Modified Jefferson index	(1963)
10.	Sly index	(1964)
11.	Best lifted index	(Fugita 1965)
12.	Totals index	(Miller 1967)
13.	Sweat index	(AFGWC 1972)

Showalter index

$S = T500 - LT(850)$

T500 = temp at 500 mb
LT(850) = temp of 850mb parcel after lifted dry-adiabatically then pseudo-adiabatically to 500 mb.

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1. index not temp dependent (i.e. value of stability index does not change with temp of air column while actual stability condition remains unchanged)
2. not to be used for stations above 1000 meters
3. need use of tephigram to solve graphically; difficult to solve numerically usually done empirically.

general criteria

>3	no thunderstorms
0-3	not likely to get thunderstorms
m3-0	thunderstorms may occur
m3-m6	heavy thunderstorms
<m6	severe thunderstorms

Lifted index

L = T500 - LT (sfc)

T500 = temp at 500 mb
LT (sfc) = temp of air parcel lifted dry adiabatically then pseudo-adiabatically to 500 mb from 25 mb using the mean temp and dewpt in layer 50 mb above sfc.

1. modified from Showalter
2. can be better extrapolated from sfc reports
3. better index for sfc based convection since reflects both latent instability and effect of sfc heating
4. recognizes case where low-level moisture does not extend through 850 mb
5. index not temp depenedent (i.e. value of stability, index does not change with temp of air column while actual stability condition remains unchanged)

general criteria

m3-0 thunderstorms may occur
<m3 thunderstorms occur

K-index

K = (T850 - T500) + Td850 - (T700 - Td700)

T850 = temp at 850 mb
T500 = temp at 500 mb
T700 = temp at 700 mb
Td700= dewpt. temp at 700 mb
Td850= dewpt. temp at 850 mb

1. linear combination of temps and dewpts - uses low and mid-level moisture
2. index is temp dependent (i.e., value of stability index changes with temp of air column while actual stability condition remains unchanged)
3. George found index best for airmass convection (away from winds, cyclonic development and fronts)
4. measure of thunderstorm potential
5. uses temp diff 850-500 to parameterize vertical temp lapse rate; uses 850 and 700 mb dewpts to examine vertical depth of moisture.

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general criteria

≤20	none
20-25	isolated
25-30	widely scattered
30-35	scattered
>35	numerous

Sly-index

$Y = 1.6\,\theta w(21m) - T500(00) - 11$

$\theta w(21m)$ = wet bulb potential temp computed from max sfc temp and representative afternoon dewpoint (2100Z)

$T500(00)$ = temp at 500 mb at 00Z

1. developed for use in Alberta
2. modification of Rackcliff and Jefferson indices
3. could use as first guess the 1200Z dewpt for the 2100Z dewpoint in formula

general criteria

<29	no thunderstorms
29-31	thunderstorms if moisture available
>31	thunderstorms
>35	hail occurs if fronts pass 75% chance if no frontal passage

Totals index

T.I. = Cross totals + Vertical totals
= (Td850 - T500) + (T850 - T500)
= Td850 +T850 - 2(T500)

Td850 = dewpt temp at 8500 mb
T850 = temp at 850 mb
T500 = temp at 500 mb

1. based only on 850 and 500 mb levels
2. introduced by Miller
3. useful for locating potential areas of thunderstorms

general criteria

46	scattered, few moderate
48	scattered, few moderate, isolated severe
50	scattered moderate, few severe, isolated tornadoes
52	scattered to numerous moderate, few scattered, few tornadoes
56	numerous moderate, scattered severe and tornadoes

note: moderate thunderstorms
- max gusts 34-50 knots and hail if any ½ - 1 inch
severe thunderstorms
- max gusts 50 or greater or hail ≥1 inch.