Subject: Skew-T, Log(P) Diagram
Posted by afl on Tue, 04 Apr 1995 07:00:00 GMT
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Greetings!

A while back someone asked for an IDL procedure that
is capable of producing a Skew-T, Log(P) diagram. If you
have one, then I have been wasting my time... because I have just
finished beating my head against a wall writing this code
which accomplishes the task (thought it would be nice code
to have lying around). It is not well tested, so please
send comments to afl@cdc.noaa.gov so I can work out any bugs.

Now one must learn to plot sounding data onto the chart.
Use the Tnew function to find Temp. in the "skewed"
coordinate system!

It will also be nice to have the program compute such
quantities as the Wet bulb temp, LCL, LFC, CAPE, etc.
That's for the future.

Andy

```
;  PROCEDURE TO DRAW A SKEW-T, Log(P) DIAGRAM GIVEN A DESIRED
;  TEMPERATURE RANGE FOR THE DATA.
;
;  Originator:  Andrew F. Loughe
;

PRO SKEWT, TRANGE, everyT=everyT, everyDA=everyDA, $
          everySA=everySA, everyW=everyW, title=title, notitle=notitle
on_error, 2

if (n_elements(everyT)  le 0) then everyT  = 10   ; T  = Temperature
if (n_elements(everyDA) le 0) then everyDA = 10   ; DA = Dry adiabat
if (n_elements(everySA) le 0) then everySA = 1    ; SA = Saturated adiabat
if (n_elements(everyW)  le 0) then everyW  = 1    ; W  = Mixing ratio

if (not keyword_set(title)) then title='Skew-T, Log(P) Diagram'
if (keyword_set(notitle))   then title=' '

if (N_params() eq 0) then $
  message,$
  'EXAMPLE:  skewt, [-20, 20], everyT=10, everyDA=10, everySA=2, everyW=2'
```

```
;  Set some defaults
prange   = [1050, 100]   ; Set default pressure range
charsize = .8            ; Set default character size

RED   = 44
GREEN = 22
BLUE  = 33
BLACK = 0
WHITE = 1


;  Make plot square for arbitrarily chosen trange of 80 degrees.
;  Code from Ken Bowman

if (!d.name eq 'PS') then device, /inch, xsize=7, ysize=7

daspect = FLOAT(!D.Y_SIZE)/FLOAT(!D.X_SIZE) * (trange(1)-trange(0))/80.
margin  = 0.1
aspect  = 1.0 ; A square
x0 = 0.50 - (0.5 - margin)*(daspect/aspect)
y0 = margin
x1 = 0.50 + (0.5 - margin)*(daspect/aspect)
y1 = 1.0 - margin

!P.POSITION = [x0, y0, x1, y1]    ; Set value of sytem variable.


;  Determine character height and width.  Apply charsize.
char_ht = convert_coord([0, !d.y_ch_size], /device, /to_norm)
char_ht = char_ht(1) * 1.0
if (!d.name ne 'X' and charsize gt 1.) then $
   char_ht = char_ht * charsize
char_wd = convert_coord([0, !d.x_ch_size], /device, /to_norm)
char_wd = char_wd(1)


;  Create the plot space.
plot_io, trange, prange, yrange=prange, /nodata, /xs, /ys, $
        xticklen=.01, ytickname=replicate(' ',30), charsize=charsize, $
        title=title

;  Print PRESSURE title along the y-axis.
lnt=alog(prange(1))  &  lnb=alog(prange(0))  &  avg=exp(.5*(lnt+lnb))
xy = convert_coord([trange(0), avg],/data,/to_norm)
xyouts, xy(0)-(5.*char_wd), xy(1), 'PRESSURE  (hPa)', orient=90, $
      /norm, align=.5

;  Print TEMPERATURE title along the x-axis.
```

```
xy = convert_coord([.5*(trange(0)+trange(1)), prange(0)], /data, /to_norm)
xyouts, xy(0), xy(1)-(3.*char_ht), 'TEMPERATURE (!uo!nC)', align=.5, /norm

;  Draw Pressure labels next to tick marks along the y-axis.
pressures = [1050,1000,900,800,700,600,500,400,300,200,100]
for i = 0, 10 do begin
   ytick = pressures(i)
   if (ytick ge prange(1)) then begin
      xy = convert_coord( [trange(0), ytick], /data, /to_norm )
      xyouts, xy(0)-(.2*char_wd), xy(1)-(.25*char_ht), $
         strcompress(string(ytick),/remove_all), align=1, $
         charsize=charsize, /norm

      plots, [trange(0), trange(1)], [ytick, ytick]  ; Horizontal line.
   endif
endfor

clip=[trange(0),prange(0),trange(1),prange(1)]   ; Define clipping space.

 ;============================================================ ============
;  Draw skewed isotherms every "everyT (10C)"  (Lines are straight).
for temp = trange(0)-100, trange(1)+5, everyT do begin
   x0 = temp
   y0 = prange(0)
   x1 = temp
   y1 = prange(1)

;  Draw the line.
   newx0 = tnew(prange(0), x0, y0)  ; Find rotated temperature position
   newx1 = tnew(prange(0), x1, y1)  ; Find rotated temperature position
   plots, [newx0, newx1], [y0, y1], color=BLUE, clip=clip, noclip=0

;  Draw line labels
;  Use method #1 in xy function to determine a place for the label.
      drew_label = 'no'
      xy = Told(prange, trange, temp, 1)
      if ( xy(0) gt trange(0) and xy(0) lt trange(1) and $
           xy(1) gt prange(1) and xy(1) lt prange(0) ) then begin
             drew_label = 'yes'
             xyouts, xy(0), xy(1), strcompress(string(fix(temp)), /rem),$
                    color=BLUE, orient=45, align=.5, charsize=charsize
      endif

;  Use method #2 in xy function to determine a place for the label.
      if (drew_label eq 'no') then xy = Told(prange, trange, temp, 2)
      if ( xy(0) gt trange(0) and xy(0) lt trange(1) and $
           xy(1) gt prange(1) and xy(1) lt prange(0) and $
           drew_label eq 'no') then begin
```

```
            xyouts, xy(0), xy(1), strcompress(string(fix(temp)), /rem),$
                  color=BLUE, orient=45, align=.5, charsize=charsize
      endif

endfor

 ;============================================================ ============
;  Draw dry adiabats every "everyDA (10C)"  (Lines are curved).
for temp = trange(0), trange(0)+220, everyDA do begin
   x1  = float(temp)
   y1  = 1050.
   inc = -2.     ; Lines will be curved, so use a small press. increment.
   drew_label='no'
   icount = 0

;  Dry adiabats from 1050mb up to prange(1).
;  For a given temperature and pressure, compute theta and plot a line.
for press = y1, prange(1), inc do begin
   icount = icount + 1
   x0 = float(x1)                          ; Orig Temp
   y0 = float(press + inc)                    ; Orig Press
   y1 = float(y0 + inc)                     ; New  Press
   x1 = (temp+273.16) * ( y1 / 1000. ) ^ (287./1004.)   ; New Temp
   x1 = x1 - 273.16

   newx0 = tnew(prange(0), x0, y0)  ; Find rotated temperature position
   newx1 = tnew(prange(0), x1, y1)  ; Find rotated temperature position


;  Draw the labels.
   if (fix(x1) eq fix(trange(0)) and drew_label eq 'no') then begin
      drew_label='yes'
      if ( newx1 gt trange(0) and newx1 lt trange(1) and $
           y1 gt prange(1) and y1 lt prange(0) ) then $
           xyouts,newx1,y1,strcompress(string(fix(temp)),/remove),$
             align=.5, color=RED, charsize=charsize, orientation=-45
   endif

;  Draw the line.
   if (icount gt 1) then $
   plots, [newx0, newx1], [y0, y1], color=RED, clip=clip, noclip=0
   if (newx1 lt trange(0)) then goto, jump2
endfor

jump2: dummy=0
endfor

 ;============================================================ ============
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;  Draw saturated adiabats.  Begin at 40C and step backwards by 4C.
;  These lines are curved.
TS = 40.
FOR TS = 40, -64, -everySA*4 DO BEGIN
  P   = 1060.
  TK  = TS + 273.16
  AOS = OS(TK, 1000.)

  ATSA  = TSA(AOS, P) - 273.16
  FOR J = 0, 85 DO BEGIN
    P0 = P
    T0 = ATSA

    P = P - 10.
    ATSA = TSA(AOS, P) - 273.16
    if (j gt 0) then begin
      newx0=tnew(prange(0),T0,P0)  ; Find rotated temperature position
      newx1=tnew(prange(0),ATSA,P) ; Find rotated temperature position

;  Leave a space for the labels and draw them.
      if (P gt 520 or P lt 510) then $
        plots, [newx0, newx1], [P0, P], $
              color=GREEN, clip=clip, noclip=0

      if ( P eq 520 ) then begin
        if (newx1 gt trange(0) and newx1 lt trange(1)) then $
         xyouts,newx1,P,strcompress(string(fix(TS)),/remove),align=.5 ,$
              color=GREEN, charsize=charsize
      endif
    endif
  ENDFOR

ENDFOR

 ;============================================================ ============
;  Draw mixing ratio lines (Lines are straight).
;  Find temperature for a given Ws (g/kg) and Press (mb).

Ws=[ .1,.2,.4,.6,.8,1.,1.5,2.,2.5,4,5,6,7,8,9,10,12, $
    14,16,18,20,24,28,32,36,40,44,48,52,56,60,68,76,84  ]

for i = 0, N_elements(Ws)-1, everyW do begin
  press1 = prange(0)
  tmr1   = tmr(Ws(i), press1) - 273.16

  press2 = 200.
  tmr2   = tmr(Ws(i), press2) - 273.16
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```
   newx0=tnew(prange(0),tmr1,press1) ; Find rotated temperature position
   newx1=tnew(prange(0),tmr2,press2) ; Find rotated temperature position

;  Draw the line.
   plots, [newx0, newx1], [press1, press2], color=22, linestyle=2, $
          clip=clip, noclip=0

;  Draw the line label.
   drew_label='no'
   if (newx0 gt trange(0) and newx0 lt trange(1)) then begin
      drew_label='yes'
      if (Ws(i) ge 1.0) then $
      xyouts, newx0, press1-2, strcompress(string(fix(Ws(i))),/remove),$
             align=.5,color=GREEN, charsize=charsize
      if (Ws(i) lt 1.0) then $
      xyouts, newx0, press1-2, string(Ws(i),format='(f3.1)'), align=.5,$
            color=GREEN, charsize=charsize
   endif
   if (newx1 gt trange(0) and newx1 lt trange(1)) then begin
      if (Ws(i) ge 1.0) then $
      xyouts, newx1, press2-2, strcompress(string(fix(Ws(i))),/remove),$
             align=.5, color=GREEN, charsize=charsize
      if (Ws(i) lt 1.0) then $
      xyouts, newx1, press2-2, string(Ws(i),format='(f3.1)'), align=.5,$
            color=GREEN, charsize=charsize
   endif

endfor

 ;=============================================================== ============
; Redraw the plot boundary.
plots, [trange(0),trange(1),trange(1),trange(0),trange(0)], $
       [prange(0),prange(0),prange(1),prange(1),prange(0)], thick=2

;  Close Postscript device, rename output file, return to calling program.
if ( !d.name eq 'PS') then begin
   device, /close
   spawn, 'mv idl.ps skewt.ps'
   set_plot, 'X'
endif

END
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