

```

pro Legende,n_color,color,pas,position_x_fin, $
    position_y_debut,position_y_fin,debut,ichamp

x0=position_x_fin+0.01
x1=x0+0.015
y1=position_y_debut
largeur=(position_y_fin-position_y_debut) / float((n_color-1))

index=fltarr(n_color)

for i=0,(n_color-1) do begin
    y0=y1
    y1=y0+largeur
    POLYFILL, [x0,x0,x1,x1], [y0,y1,y1,y0], color=color(i),/normal

    if ichamp eq 0 or ichamp eq 1 then begin
        if i eq 0 then XYOUTS,x1,y0,STRING
(FORMAT='(f6.0)',i*pas+debut), $
            SIZE=1.0, charthick=2., ALIGNMENT=0., /NORMAL
        if i eq n_color-1 then XYOUTS,x1,y0,STRING(FORMAT='(f6.0)',(i+
1)*pas+debut), $
            SIZE=1.0, charthick=2., ALIGNMENT=0., /NORMAL
        endif
    endif

    if ichamp eq 2 then begin
        if i eq 0 then XYOUTS,x1,y0,STRING(FORMAT='(i4)', '10')+$
            STRING(FORMAT='(a2,f4.1,a2)', '!e',i*pas+debut), $
            SIZE=1.0, charthick=2., ALIGNMENT=0.,
/NORMAL
        if i eq n_color-1 then XYOUTS,x1,y0,STRING(FORMAT='(i4)', '10')
+$
            STRING(FORMAT='(a2,f4.1,a2)', '!e', (i+1)
*pas+debut), $
            SIZE=1.0, charthick=2., ALIGNMENT=0.,
/NORMAL
        endif
    endif

    if ichamp eq 3 then begin
        if i eq 0 then XYOUTS,x1,y0,STRING(FORMAT='(i4)', '10')+$
            STRING(FORMAT='(a2,i2,a2)', '!e',i*pas+debut), $
            SIZE=1.0, charthick=2., ALIGNMENT=0.,
/NORMAL
        if i eq n_color-1 then XYOUTS,x1,y0,STRING(FORMAT='(i4)', '10')
+$
            STRING(FORMAT='(a2,i2,a2)', '!e', (i+1)
*pas+debut), $
            SIZE=1.0, charthick=2., ALIGNMENT=0.,
/NORMAL
        endif
    endif

    if ichamp eq 4 then begin
        if i eq 0 then XYOUTS,x1,y0,STRING(FORMAT='(f6.2)',float(i)
*pas+debut), $
            SIZE=1.0, charthick=2., ALIGNMENT=0., /NORMAL
        if i eq n_color-1 then XYOUTS,x1,y0,STRING
(FORMAT='(f6.2)',float(i+1)*pas+debut), $
            SIZE=1.0, charthick=2., ALIGNMENT=0., /NORMAL
        endif
    endif

    index(i)=float(i)*pas+debut

    if i gt 1 and i lt n_color-2 then begin

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```

        if ichamp eq 0 then begin
            if fix(index(i-1)/10.) ne fix(index(i)/10.) then begin
                if index(i) lt 0. then XYOUTS,x1,y0,STRING
(FORMAT='(f6.0)',fix(index(i-1))),$
                SIZE=1.0,charthick=2., ALIGNMENT=0., /NORMAL
                if index(i) gt 0. then XYOUTS,x1,y0,STRING
(FORMAT='(f6.0)',fix(index(i))),$
                SIZE=1.0, charthick=2., ALIGNMENT=0., /NORMAL
            endif
        endif
        if ichamp eq 1 then begin
            if fix(index(i-1)) ne fix(index(i)) then begin
                if index(i) lt 0. then XYOUTS,x1,y0,STRING
(FORMAT='(f6.0)',fix(index(i-1))),$
                SIZE=1.0,charthick=2., ALIGNMENT=0., /NORMAL
                if index(i) gt 0. then XYOUTS,x1,y0,STRING
(FORMAT='(f6.0)',fix(index(i))),$
                SIZE=1.0,charthick=2., ALIGNMENT=0., /NORMAL
            endif
        endif
        if ichamp eq 4 then begin
            if fix(index(i-1)*100.) ne fix(index(i)*100) then begin
                if index(i) lt 0. then XYOUTS,x1,y0,STRING
(FORMAT='(f6.2)',fix(index(i-1))),$
                SIZE=1.0,charthick=2., ALIGNMENT=0., /NORMAL
                if index(i) gt 0. then XYOUTS,x1,y0,STRING
(FORMAT='(f6.2)',fix(index(i))),$
                SIZE=1.0,charthick=2., ALIGNMENT=0., /NORMAL
            endif
        endif
        if ichamp eq 2 then begin
            if fix(2.*index(i-1)) ne fix(2.*index(i)) then begin
                if index(i) lt 0. then xind=STRING(FORMAT='(i4)', '10')+
                    STRING(FORMAT='(a2,f4.1,a2)', '!
e',fix(2*index(i-1))/2., '!n')
                if index(i) lt 0. then XYOUTS,x1,y0,xind,SIZE=
1.0,charthick=2., ALIGNMENT=0., /NORMAL
                if index(i) gt 0. then xind=STRING(FORMAT='(i4)', '10')+
                    STRING(FORMAT='(a2,f4.1,a2)', '!
e',fix(index(i)), '!n')
                if index(i) gt 0. then XYOUTS,x1,y0,xind,SIZE=
1.0,charthick=2., ALIGNMENT=0., /NORMAL
            endif
        endif
        if ichamp eq 3 then begin
            if fix(index(i-1)) ne fix(index(i)) then begin
                if index(i) lt 0. then xind=STRING(FORMAT='(i4)', '10')+
                    STRING(FORMAT='(a2,i2,a2)', '!
e',fix(index(i-1)), '!n')
                if index(i) lt 0. then XYOUTS,x1,y0,xind,SIZE=
1.0,charthick=2., ALIGNMENT=0., /NORMAL
                if index(i) gt 0. then xind=STRING(FORMAT='(i4)', '10')+
                    STRING(FORMAT='(a2,i2,a2)', '!
e',fix(index(i)), '!n')
                if index(i) gt 0. then XYOUTS,x1,y0,xind,SIZE=
1.0,charthick=2., ALIGNMENT=0., /NORMAL
            endif
        endif

        if index(i-1) lt 0. and index(i) ge 0. and ichamp ne 2 and
ichamp ne 4 then $
            XYOUTS,x1,y0,STRING(FORMAT='(f6.0)',fix(index(i))),SIZE=
1.0,charthick=2., ALIGNMENT=0.,/NORMAL
            if index(i-1) lt 0. and index(i) ge 0. and ichamp eq 2 then $
                XYOUTS,x1,y0,STRING(FORMAT='(i4)', '10')+
                STRING(FORMAT='(a2,f4.1,a2)', '!e',fix(index(i)), '!n'),SIZE=

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1.0,charthick=2., ALIGNMENT=0.,/NORMAL
    if index(i-1) lt 0. and index(i) ge 0. and ichamp eq 4 then $
        XYOUTS,x1,y0,STRING(FORMAT='(f6.2)',fix(index(i))),SIZE=
1.0,charthick=2., ALIGNMENT=0.,/NORMAL

    endif

endfor

return
end

PRO sub_recuptable,Red,Green,Blue,Ctable,CMTable
COMMON COLORS,R_ORIG,G_ORIG,B_ORIG,R_CURR,G_CURR,B_CURR
COMMON NORMColors,Norm

R_CURR(0)=255
G_CURR(0)=255
B_CURR(0)=255

get_lun,lunit
openr,lunit,'colorscale_reading.txt'

for i=0,63 do begin
    readf,lunit,r1,g1,b1
    R_CURR(i+1)=r1
    G_CURR(i+1)=g1
    B_CURR(i+1)=b1
endfor
close,lunit
free_lun,lunit

Red=R_CURR
Green=G_CURR
Blue=B_CURR

Norm= 256L
TVLCT,R_CURR,G_CURR,B_CURR
CTable=LINDGEN(!D.N_COLORS < 256L)
IF (!D.N_COLORS GT 256L) THEN BEGIN
    CTable=Red+Norm*(Green+Norm*Blue)
    CMTable = CTable
ENDIF ELSE BEGIN
    CMTable=Red+Norm*(Green+Norm*Blue)
ENDELSE

END

;*****
;   MAIN PROGRAM
;*****

; Program which reads SCM simulations from TWP-ICE (Greg Roff) and
; converts
; the Ice Water Content into two reflectivities at two different
; wavelengths
; (35 and 95 GHz)

; V1.0 01/05/2008 A. Protat

nom_read='/bm/gdata/aprotat/TWPICE/twpice_scm63pc2linux.nc'

cdfid=ncdf_open(nom_read)

nheight=0
nid=ncdf_dimid(cdfid,'wet_levels')

```

```

ncdf_diminq,cdfid,nid,wet_levels,nheight
print,'heights : ',wet_levels,nheight

ntime=0
nid=ncdf_dimid(cdfid,'time')
ncdf_diminq,cdfid,nid,time,ntime
print,'times : ',time,ntime

height=fltarr(nheight)
nid=ncdf_varid(cdfid,'wet_levels')
ncdf_varget,cdfid,nid,height

nid=ncdf_varid(cdfid,'all_levels')
ncdf_varget,cdfid,nid,all_levels

xtime=fltarr(ntime)
nid=ncdf_varid(cdfid,'time')
ncdf_varget,cdfid,nid,xtime

temp=fltarr(nheight,ntime)
nid=ncdf_varid(cdfid,'T')
ncdf_varget,cdfid,nid,temp

ice_mixing_ratio=fltarr(nheight,ntime) ; en kg / kg
rho=fltarr(nheight,ntime) ; en kg / m-3
iwcmoel=fltarr(nheight,ntime) ; en g m-3

nid=ncdf_varid(cdfid,'qcf')
ncdf_varget,cdfid,nid,ice_mixing_ratio
nid=ncdf_varid(cdfid,'rho_only')
ncdf_varget,cdfid,nid,rho
iwcmoel(*,*) = 1000. * ice_mixing_ratio (*,*) * rho (*,*)

tempmin = -80.
tempmax = 0.
dtemp = 0.2
ntemp = fix((tempmax-tempmin)/dtemp) + 1
tempth = fltarr(ntemp)
for i=0,ntemp-1 do tempth(i) = tempmin + float(i)*dtemp + dtemp/2.

Zmin = -50.
Zmax = 30.
dZ = 0.2
nZ = fix((Zmax-Zmin)/dZ) + 1
Zth = fltarr(nZ)
for i=0,nZ-1 do Zth(i) = Zmin + float(i)*dZ + dZ/2.

IWCth_35=fltarr(nZ,ntemp)
IWCth_95=fltarr(nZ,ntemp)

for j=0,ntemp-1 do begin
  for i=0,nZ-1 do begin
    ; *****
    ; Compute IWC from IWC-Z-T (Protat et al. 2007, JAMC)
    ; *****

    logiwcz_t_35 = 0.000234*Zth(i)*tempth(j) + 0.0747*Zth(i) -
0.0111*tempth(j) - 1.41 ; global relationship at 35 GHz
    ; logiwcz_t_35 = 0.000185*Zth(i)*tempth(j) + 0.0735*Zth(i) -
0.0091*tempth(j) - 1.31 ; tropical relationship at 35 GHz

    logiwcz_t_95 = 0.000491*Zth(i)*tempth(j) + 0.0939*Zth(i) -
0.0023*tempth(j) - 0.84 ; global relationship at 95 GHz
    ; logiwcz_t_95 = 0.000457*Zth(i)*tempth(j) + 0.0969*Zth(i) -
0.0002*tempth(j) - 0.61 ; tropical relationship at 95 GHz
  
```

```

        IWCth_35(i,j) = ( 10.^(logiwczth_35) ) ; IWC in g m-3
        IWCth_95(i,j) = ( 10.^(logiwczth_95) ) ; IWC in g m-3

    endfor
endfor

Z_35=fltarr(ntime,nheight)
Z_95=fltarr(ntime,nheight)
logIWC=fltarr(ntime,nheight)

for j=0,nheight-1 do begin
    print,'Level ',j+1,' out of ',nheight

    for i=0L,ntime-1L do begin

        if iwcmode(j,i) ne 0. then logIWC(i,j) = alog10(iwcmode
(j,i))
        if iwcmode(j,i) eq 0. then logIWC(i,j) = -999.0

        indtemp = fix((temp(j,i)-273.15-tempmin)/dtemp) + 1

        diff35 = 1.e10
        diff95 = 1.e10
        indZ_35 = -1000
        indZ_95 = -1000

        for iZ=0,nZ-1 do begin

            if indtemp ge 0 and indtemp le ntemp-1 then begin

                if abs( IWCth_35(iZ,indtemp)-iwcmode(j,i) ) lt diff35
and iwcmode(j,i) ne 0. then begin

                    diff35 = abs( IWCth_35(iZ,indtemp)-iwcmode(j,i) )
                    indZ_35=iZ

                endif

            endif

            if indtemp ge 0 and indtemp le ntemp-1 then begin

                if abs( IWCth_95(iZ,indtemp)-iwcmode(j,i) ) lt diff95
and iwcmode(j,i) ne 0. then begin

                    diff95 = abs( IWCth_95(iZ,indtemp)-iwcmode(j,i) )
                    indZ_95=iZ

                endif

            endif

        endif

    endfor

    if indZ_35 ge 0 and indZ_35 le nZ-1 then begin

        Z_35(i,j) = Zth(indZ_35)

    endif else begin

        Z_35(i,j) = -999.0

    endelse

```

```

        if indZ_95 ge 0 and indZ_95 le nZ-1 then begin
            Z_95(i,j) = Zth(indZ_95)
        endif else begin
            Z_95(i,j) = -999.0
        endelse
    endfor
ENDFOR

; *****
; DISPLAY RESULTS
; *****

SET_PLOT , 'PS'
LOADCT, 41, FILE='Alain.tbl'
DEVICE,XOFFSET=0.2,YOFFSET=0.,XSIZE=20.,YSIZE=
20.,filename='/bm/gdata/aprotat/reffromscm.ps', /color

sub_recuputable,Red,Green,Blue,Ctable,CMTable
!P.MULTI=[0,0,1,0,0]
!p.background=0
!p.color=255

px1=[0.20,0.80]
py1=[0.10,0.30]
py2=[0.40,0.60]
py3=[0.70,0.90]

nbniv = 64
tab_col = fltarr(nbniv)

for i=0,nbniv-1 do tab_col(i)=float(i) + 1.

tab_cot_ref = fltarr(nbniv)
min_cot_ref=-50.
max_cot_ref= 30.
pas_cot_ref = (max_cot_ref-min_cot_ref)/(nbniv)
for i=0,nbniv-1 do tab_cot_ref(i)=min_cot_ref+i*pas_cot_ref

tab_cot_iwc = fltarr(nbniv)
min_cot_iwc=-5.
max_cot_iwc= 0.
pas_cot_iwc = (max_cot_iwc-min_cot_iwc)/(nbniv)
for i=0,nbniv-1 do tab_cot_iwc(i)=min_cot_iwc+i*pas_cot_iwc

contour,logIWC,xtime,height/1000.,nlevels=nbniv,c_color=tab_col,$
title='log (IWC (gm!e-3!n)) from TWP-ICE SCM output', $
MIN_VALUE=min_cot_iwc,yrange=[0.,20.],$
levels=tab_cot_iwc,xstyle=1,ystyle=1,$
xtitle='Time (hours since 2006-01-19 03:00:00)', ytitle='Height
(km)', $
POSITION=[px1(0),py3(0),px1(1),py3(1)], $
charsize=0.8,charthick=2.0,/noclip,/CELL_FILL,/noerase

Legende, nbniv,tab_col,pas_cot_iwc,px1(1)+0.01, $
py3(0)-0.02,py3(1),min_cot_iwc,1

contour,Z_35,xtime,height/1000.,nlevels=nbniv,c_color=tab_col,$
title='Reflectivity at 35 GHz from TWP-ICE SCM output', $
MIN_VALUE=min_cot_ref,yrange=[0.,20.],$
levels=tab_cot_ref,xstyle=1,ystyle=1,$

```

```

    xtitle='Time (hours since 2006-01-19 03:00:00)', ytitle='Height
(km)', $
    POSITION=[px1(0),py2(0),px1(1),py2(1)], $
    charsize=0.8,charthick=2.0,/noclip,/CELL_FILL,/noerase

Legende, nbniv,tab_col,pas_cot_ref,px1(1)+0.01, $
    py2(0)-0.02,py2(1),min_cot_ref,0

contour,Z_95,xtime,height/1000.,nlevels=nbniv,c_color=tab_col,$
    title='Reflectivity at 95 GHz from TWP-ICE SCM output', $
    MIN_VALUE=min_cot_ref,yrange=[0.,20.],$
    levels=tab_cot_ref,xstyle=1,ystyle=1,$
    xtitle='Time (UTC)', ytitle='Height (km)', $
    POSITION=[px1(0),py1(0),px1(1),py1(1)], $
    charsize=0.8,charthick=2.0,/noclip,/CELL_FILL,/noerase

Legende, nbniv,tab_col,pas_cot_ref,px1(1)+0.01, $
    py1(0)-0.02,py1(1),min_cot_ref,0

DEVICE,/CLOSE
print,' *** Converting PS to JPG ...'
spawn,'convert -trim -quality 80 -density 200x200
/bm/gdata/aprotat/reffromscm.ps
/bm/gdata/aprotat/TWPICE/ref_from_scm.jpg'

; *****
; WRITE RESULTS IN NETCDF FILE
; *****

nom_write='/bm/gdata/aprotat/TWPICE/reflectivity_from_scm.nc'
idw=NCDF_CREATE(nom_write)

hid=NCDF_DIMDEF(idw,'levels',nheight)
tid=NCDF_DIMDEF(idw,'time',ntime)

timeid=NCDF_VARDEF(idw,'time',[tid],/FLOAT)
NCDF_ATTPUT,idw,timeid,'units','hours since 2006-01-19 03:00:00'
NCDF_ATTPUT,idw,timeid,'comment','hours as in the original SCM file'

heightid=NCDF_VARDEF(idw,'wet_levels',[hid],/FLOAT)
NCDF_ATTPUT,idw,heightid,'comment','wet levels in the original SCM
file'

ref35id=NCDF_VARDEF(idw,'Z_35GHz',[tid,hid],/FLOAT)
NCDF_ATTPUT,idw,ref35id,'units','dBZ'
NCDF_ATTPUT,idw,ref35id,'comment','unattenuated reflectivity at 35
GHz computed from model IWC and temperature following Protat et al.
(2007, JAMC)'

ref95id=NCDF_VARDEF(idw,'Z_95GHz',[tid,hid],/FLOAT)
NCDF_ATTPUT,idw,ref95id,'units','dBZ'
NCDF_ATTPUT,idw,ref95id,'comment','unattenuated reflectivity at 95
GHz computed from model IWC and temperature following Protat et al.
(2007, JAMC)'

NCDF_CONTROL,idw,/ENDEF

NCDF_VARPUT,idw,timeid,xtime
NCDF_VARPUT,idw,heightid,height
NCDF_VARPUT,idw,ref35id,Z_35
NCDF_VARPUT,idw,ref95id,Z_95

NCDF_CLOSE,idw

end

```