
Subject: Re: Help: antenna pattern plotting (polar plots)
Posted by [krummel13](#) on Tue, 11 May 1999 07:00:00 GMT
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In article <3736F174.4EF63625@ohm.york.ac.uk>,
Declan Vogt <drv102@ohm.york.ac.uk> wrote:
> Help! What I am trying to do is create an antenna pattern plot. This
is
> normally presented as a polar plot with r indicating field strength in
> direction theta. I have used essentially the technique suggested by
> David Fanning in his tips, but I have run into a problem:
>
> I want my axes to be positive only. For example, I'd like the X axis
to
> show values: 40 30 20 10 0 10 20 30 40, or not show values left of
the Y
> axis.
>
> Does anyone have an easy tip to do this? Or does anyone have code to
> display antenna patterns?
>
>
Hi All,

Sorry about that previous post, a slip of the mouse!

Anyway, I have written a routine to plot a wind rose (well what we call a wind rose anyway). This is very similar to what you are calling an antenna plot ie a polar plot. One possible difference is that for meteorological plots, zero degrees starts at due north, so there is an offset in the angle. I have included the routine below, you can extract the bits that apply for you and modify as necessary. I have done the axis labelling slightly different to what David F. suggested in his post. This was done to avoid having to explicitly set the formatting (I4) and thus hopefully making the routine more general. I hope this code helps you out!

I have seen requests in this newsgroup before for wind rose code so I guess here is my attempt. Any suggestions for improving the code are welcome. I have incorporated quite a few options into the code. These include the ability to plot a map behind the wind rose and also handle !p.multi correctly when the MAP option is used. Read the header for the full set of options.

Here are some simple examples:
set your variable and its corresponding wind direction
IDL> var=findgen(36) & wind_dirn=findgen(36)*10.
Just plot the wind rose

```
IDL> plot_wind_rose,var,wind,color=250
Close the wind rose
IDL> plot_wind_rose,var,wind,color=250,/copy_first
Plot the wind rose with the default map (centred on Cape Grim Australia)
IDL> plot_wind_rose,var,wind,color=250,/copy_first,/map
Plot the wind rose with a map centred on california somewhere and
zoomed out some with corss hairs
IDL> plot_wind_rose,var,wind,color=250,/copy_first, $
    map=[33,243],e_map={scale:10e6},/cross_hairs
Note that the default is to use hires maps with the COASTS keyword from
map_continent, this can be turned off like this:
IDL> plot_wind_rose,var,wind,color=250,/copy_first, $
    map=[33,243],e_map={scale:10e6},e_cont={hires:0,coasts:0}, $
    /cross_hairs
Or if you want the hires coast without the islands/lakes etc then set
hires to 1 and coasts to 0.
```

Anyway, I hope this code is useful.
Cheers Paul

```
~~~~~
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~~~~~
```

```
FUNCTION CIRCLE, xcenter, ycenter, radius, nPts=nPts
```

```
IF N_Elements(nPts) EQ 0 THEN nPts = 100
points = (2 * !PI / (nPts-1)) * FIndGen(nPts)
x = xcenter + radius * Cos(points)
y = ycenter + radius * Sin(points)
RETURN, Transpose([[x],[y]])
```

```
END
;+
; NAME:
; PLOT_WIND_ROSE
;
; PURPOSE:
; This procedure will plot a given variable against
; wind direction in a polar plot. This type of plot
; is commonly known as a wind rose in meteorology.
; The routine has several options including the option
; of plotting the rose centred over a particular map
; location. Other options include placing baseline
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; indicators, any number of circles and cross hairs
; onto the plot.
;
; CATEGORY:
; Plotting/meteorology.
;
; CALLING SEQUENCE:
; PLOT_WIND_ROSE, Var, Wind_Dirn
;
; INPUTS:
; Var: This is the variable to plot on the wind rose.
; This is an array of the same length as Wind_Dirn
; corresponding to each element in Wind_Dirn.
; Wind_Dirn: This is the wind direction in degrees.
;
; KEYWORD PARAMETERS:
; TITLE: A string that contains a title for the plot.
; COLOR: This controls the colour of the wind rose line.
; Default color is 0.
; THICK: This controls the thickness of the wind rose
; line. Default thickness is 4.
; LINESSTYLE: This controls the linestyle of the wind rose
; line. Default linestyle is 0.
;
; YTITLE: A string that contains a title for the y-axis.
; YTHICK: This controls the thickness of the y-axis.
; Default thickness is 2.
; YMINOR: This controls the number of minor tickmarks.
; Default is 5.
;
; CROSS_HAIRS: Set this keyword to place tick marks on
; the horizontal and vertical radial lines through
; the centre of the plot.
; E_CROSS: Set this keyword to a structure that will
; contain any keywords used in the AXIS procedure.
; The AXIS procedure is used to draw the cross hairs.
;
; BASELINE: Set this keyword if baseline indicator lines
; are required. The default is plot the baseline
; indicators for Cape Grim, Tasmania ie lines at 190
; and 280 degrees. To change this, set this keyword to
; an array of the angles required ie BASELINE=[150.,290.]
; This array can contain any number of angles as long
; as there is more than 1 angle.
; E_BASE: Set this keyword to a structure that will contain
; any keywords used in the OPLOT procedure ie linestyle,
; color, thickness etc. Defaults are the same as used
; in OPLOT.

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;
;
; E_MAP: Set this keyword to a structure that will contain
; any keywords used in the MAP_SET procedure. Use this
; to set the map scale or projection. The map scale
; controls what the map region is. The default is 5.e6
; so a map of scale 1:5e6 is plotted centred on the given
; lat and lon. DO NOT use this to set actual plotting
; features ie color, thickness, fill etc Use the E_CONT
; keyword described below.
; E_MAP: Set this keyword to a structure that will contain
; any keywords used in the MAP_SET procedure. Use this
; to set the map scale or projection. The map scale
; controls what the map region is. The default is 5.e6
; so a map of scale 1:5e6 is plotted centred on the given
; lat and lon. DO NOT use this to set actual plotting
; features ie color, thickness, fill etc Use the E_CONT
; keyword described below.
; E_CONT: Set this keyword to a structure that will contain
; any keywords used in the MAP_CONTINENTS procedure. Use
; this to set plotting variables of the map such as line
; thickness, color, turn high res/coasts off, etc.
; GRID: Set this keyword to plot a grid on the map using
; MAP_GRID.
; E_GRID: Set this keyword to a structure that will contain
; any keywords used in the MAP_GRID procedure. Use this
; keyword to set the linestyle, thickness, color, labels
; etc for the grid. Refer to MAP_GRID.
;
;
; N_CIRC: Set this keyword to an array containing values
; between zero and one indicating where to plot the
; circles on the wind rose. The default if this is not
; set is to plot two circles, one at 0.5 of the maximum
; value, the other at 1. If you wanted to plot 4 circles
; set this keyword to where the circles are required ie
; N_CIRC=[0.25, 0.5, 0.75, 1.0].
; E_CIRC: Set this keyword to a structure that will contain
; any keywords used in the PLOTS procedure which draws
; the circles. Use this to control the color, thicknes
; and linestyle of the circles. The defaults for these
; are the same as for the PLOTS procedure.
;
;
; COPY_FIRST: Set this keyword to copy the the first array
; element of the input arrays VAR and WIND_DIRN to the
; end of these arrays. This is to "close" the wind
; rose line.
;
;
; NODATA: Set this keyword to plot no data. This is useful
; for visualising wind directions for a particuar

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; location by plotting a map in the background with the
; windrose angles or coordinates over the top.
;
; EXAMPLE:
; To plot a wind rose of the variable ch4conc with a map
; centred over Cape Grim, with scale of 10e6, no grid lines
; on the map, 4 circles, cross hairs and the default
; baseline indicators:
; PLOT_WIND_ROSE, ch4conc, wind_dir, $
; color=pen(2), thick=6, linestyle=0, $
; title='Methane at Cape Grim', $
; ytitle='CH!D4!N (ppb)', /cross_hairs, $
; map=1, E_MAP={scale:10e6}, $
; E_cont={thick:4,color:pen(4)}, $
; /baseline, $
; E_BASE={thick:4, color:pen(3), linestyle:2}, $
; E_CIRC={thick:2}, n_circ=[0.25,0.5,0.75,1.0]
;
; To plot the above with filled continents and a grid
; on the map:
; PLOT_WIND_ROSE, ch4conc, wind_dir, $
; color=pen(2), thick=6, linestyle=0, $
; title='Methane at Cape Grim', $
; ytitle='CH!D4!N (ppb)', /cross_hairs, $
; map=1, E_MAP={scale:10e6}, $
; E_cont={thick:4,color:pen(4),fill_continents:1}, $
; /baseline, $
; E_BASE={thick:4, color:pen(3), linestyle:2}, $
; E_CIRC={thick:2}, n_circ=[0.25,0.5,0.75,1.0], $
; /GRID, E_GRID={thick:0.5}
;
; To plot just a simple wind rose:
; PLOT_WIND_ROSE, ch4conc, wind_dir, ytitle='CH!D4!N (ppb)'
;
; MODIFICATION HISTORY:
; Written by: Bronwyn Dunse and Paul Krummel,
; 27 October 1998, CSIRO Atmospheric Research, Australia.
; Modified by: Paul Krummel, 8 November 1998. Added map
; functionality.
; Modified by: Paul Krummel, 15 January 1999. Added many
; extra keywords (E_???), cleaned up the routine, added
; help and proper header information, also other small
; improvements and bug fixes.
; MODIFIED by: Paul Krummel, 21 January 1999. Fully documented.
; MODIFIED by: Paul Krummel, 10 February 1999. Added
; NODATA keyword.
; Modified by: Paul Krummel, 11 May 1999. Fixed Title problem
; and added COPY_FIRST keyword.

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;
;
;-
;
;
PRO PLOT_WIND_ROSE, VAR, WIND_DIRN, $
  TITLE=Title, COLOR=Color, THICK=Thick, $
  LINESTYLE=Linestyle, $
  YTITLE=YTitle, YTHICK=YThick, YMINOR=YMinor, $
  CROSS_HAIRS=Cross_hairs, E_CROSS=E_Cross, $
  BASELINE=Baseline, E_BASE=E_Base, $
  MAP=Map, E_MAP=E_Map, E_CONT=E_CONT, $
  GRID=GRID, E_GRID=E_GRID, $
  N_CIRC=N_CIRC, E_CIRC=E_CIRC, $
  COPY_FIRST=Copy_First, NODATA=Nodata

; ++++
; =====>> HELP
on_error,2
if (N_PARAMS(0) LT 2) or keyword_set(help) then begin
  doc_library,'PLOT_WIND_ROSE'
  if N_PARAMS(0) LT 2 and not keyword_set(help) then $
    message,'Need at least two input parameters, $
             see above for usage.'

  return
endif

; ++++
; Find the maximum value of the variable of interest.
; If the NODATA keyword is set then set max_var to 1.0
; and zero the var[] array.
max_var = keyword_set(nodata) ? 1.0 : max(var)
if keyword_set(nodata) then var[*]=0.0

; If the COPY_FIRST keyword is set then copy the first
; array element of VAR and WIND_DIRN to the end of these
; arrays.
if keyword_set(Copy_First) then $
  var=[var,var[0]] & wind_dirn=[wind_dirn,wind_dirn[0]]

; ++++
; Setup the plot coordinates. Make the plot isotropic and
; set the x and y range to +/- the maximum value.
PLOT, var, (450.-wind_dirn)*!DTOR, /nodata, /noerase,$
/polar, /isotropic,$
xstyle=5, ystyle=5, $
yrange=[-max_var,max_var], xrange=[-max_var,max_var]

; ++++
; If the MAP keyword is selected then plot a map behind

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; the wind rose centred on the given coordinates. If no
; coordinates are given use lat and lon for Cape Grim,
; Tasmania, Australia.
if keyword_set(MAP) then begin

; Check if there is more than one element in the map
; keyword, if so it should contain the lat and lon
; for the map centre. Set this accordingly.
if n_elements(map) gt 1 then begin
    lat=map[0] & lon=map[1]
endif else begin ; else set the default map centre
    ; to Cape Grim.
    lat=-40.6829441667D & lon=144.689568611D
endelse

; Check how many plots per page are to be made.
; Use different code for just one plot or more
; than one plot and adjust !p.multi accordingly.
if !p.multi[1] gt 1 or !p.multi[2] gt 1 then begin

;+ Code for more than one plot per page +
num_left=!p.multi[0]
if num_left eq 0 then num_left=!p.multi[1]*!p.multi[2]

; Setup the mapping here, forcing the map
; into the plot coordinates set above.
map_set, lat, lon, scale=5.e6, /merc, /noborder, $
position=[!x.window[0],!y.window[0], $
          !x.window[1],!y.window[1]], $
/advance, _EXTRA=E_MAP

; Plot the coastline here, NOTE the default
; is to use hires map.
map_continents, /coasts, /hires, _EXTRA=E_CONT

; Plot a grid on the map if requested.
if KEYWORD_SET(GRID) then map_grid, _EXTRA=E_GRID

; reset !p.multi to stop frame/page advance.
!p.multi[0]=num_left

endif else begin
;+ Code for one plot per page +

; Setup the mapping here, forcing the map
; into the plot coordinates set above.
map_set, lat, lon, /merc, scale=5.e6, /noborder, $
position=[!x.window[0],!y.window[0], $

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    !x.window[1],!y.window[1]], $
    _EXTRA=E_MAP

; Plot the coastline here, NOTE the default
; is to use hires map.
map_continents, /coasts, /hires, _EXTRA=E_CONT

; Plot a grid on the map if requested.
if KEYWORD_SET(GRID) then map_grid, _EXTRA=E_GRID

; reset !p.multi to stop from/page advance.
if !p.multi[0] le 0 then !p.multi[0]=1

endelse

endif ; End of mapping section.

; ++++
; Setup the plot coordinates again and get the tickmark values.
Title = keyword_set(Title) ? Title+'!C ' : Title
PLOT, var, (450.-wind_dirn)*!DTOR, /nodata, $
/polar, /isotropic, $
TITLE=Title, $
xstyle=5, ystyle=5, $
yrange=[-max_var,max_var],xrange=[-max_var,max_var],$
ytick_get=tick_val

; ++++
; Plot the circles here.
; Default circles at 0.5 and 1 of Max_var.
if not KEYWORD_SET(n_circ) then n_circ=[0.5,1.0]
for i=0,n_elements(n_circ)-1 do $
    PlotS, circle(0, 0, n_circ[i]*Max_var, nPts=361), _EXTRA=E_CIRC

; ++++
; Count the number of tickmarks
ntick_val=n_elements(tick_val)

; Set the negative tickmarks to positive, for use in labelling.
ptick_val=abs(tick_val)

; Set the default thickness and number of minor tick marks
; if they were not defined in the calling routine.
ythick = keyword_set(ythick) ? ythick : 2
yminor = keyword_set(yminor) ? yminor : 5

; ++++
; Plot a y-axis to the left of the rose with the tick mark values

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; and optional ytitle. Default thickness and minor tickmarks are
; used unless otherwise specified.
AXIS,-(max_var+0.22*max_var),0, YAXIS=0, YTHICK=YThick, $
YTICKNAME=format_axis_values(ptick_val), $
YTICKS=ntick_val-1, YTICKV=tick_val, $
YTITLE=YTitle, YMINOR=YMinor, $
YSTYLE=1, YRANGE=[-max_var,max_var]

; ++++
; CROSS HAIRS:
; Place tick marks on the horizontal and vertical radial
; lines through the centre of the plot if the CROSS_HAIRS
; keyword is set.
if KEYWORD_SET(Cross_hairs) then begin
  AXIS, 0, 0, YAXIS=0, YTHICK=0.5,$
  YTICKFORMAT='(a1)', $
  YTICKS=ntick_val-1, YTICKV=tick_val, $
  YMINOR=5, YSTYLE=1, $
  YRANGE=[-max_var,max_var], $
  _EXTRA=E_Cross

  AXIS, 0, 0, YAXIS=1, YTHICK=0.5,$
  YTICKFORMAT='(a1)', $
  YTICKS=ntick_val-1, YTICKV=tick_val, $
  YMINOR=5, YSTYLE=1, $
  YRANGE=[-max_var,max_var], $
  _EXTRA=E_Cross

  AXIS, 0, 0, XAXIS=0, XTHICK=0.5,$
  XTICKFORMAT='(a1)', $
  XTICKS=ntick_val-1, XTICKV=tick_val, $
  XMINOR=5, XSTYLE=1, $
  XRANGE=[-max_var,max_var], $
  _EXTRA=E_Cross

  AXIS, 0, 0, XAXIS=1, XTHICK=0.5,$
  XTICKFORMAT='(a1)', $
  XTICKS=ntick_val-1, XTICKV=tick_val, $
  XMINOR=5, XSTYLE=1, $
  XRANGE=[-max_var,max_var], $
  _EXTRA=E_Cross
endif

; ++++
; Plot the radial lines.
a=replicate(max_var,12)
b=!DTOR*[0,180,30,210,60,240,90,270,120,300,150,330]
for i=0,10,2 do OPLOT,a[i:i+1],b[i:i+1],/polar,thick=1.0

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;++++
; Annotate the radial lines.
; Setup the angles for the labels, include appropriate offsets.
l_theta=!DTOR*([360.,330.,300.,270.-1.0,240.,210.,180., $
    150.,120.,90.+1.0,60.,30.] +90.)

; Setup the radius values for the labels, including offsets.
l_radius=make_array(12,/float,value=max_var)
l_offset=max_var/[40.,35.,35.,20.,10.,10.,10.,10.,10.,11.,17.,30.]
l_radius=l_radius+l_offset

; Turn the radius and angle into rectangular coords.
polar_coord=make_array(2,12,/float)
polar_coord[0,*]=l_theta & polar_coord[1,*]=l_radius
result=cv_coord(from_polar=polar_coord,/to_rect)

; Set the label string here.
label=[' 0 ',' 30 ',' 60 ',' 90 ','120 ','150 ','180 ', $
    '210 ','240 ','270 ','300 ','330 ']

; Assign the rectangular coords.
l_x=result[0,*]
l_y=result[1,*]

; Try to set the character size for the labels according
; to the number of plots per page.
nplots=float(total(!p.multi[1:2]))
case 1 of
    nplots le 2.: chsize=1.
    nplots gt 2. and nplots le 4.: chsize=0.75
    nplots gt 4. and nplots le 6.: chsize=0.5
    nplots gt 6.: chsize=0.4
endcase

; Plot the labels.
XYOUTS, l_x, l_y, label, /data, CHARSIZE=chsize, align=0.5

;++++
; Plot two radial lines indicating the baseline sector
; if the BASELINE keyword is set. Can also be used to
; plot any type of indicating line.
if KEYWORD_SET(Baseline) then begin
; If just the baseline keyword is set then plot the
; default baseline indicators for Cape Grim, ie 190
; and 280 degrees. If there are two elements or more
; in Baseline keyword, they are angles so plot lines
; along these angles.

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```

if n_elements(Baseline) eq 1 then b_theta=[190.,280.] $
else b_theta=baseline

; Set the radius to plot out to and convert angles to
; compass coords and radians.
b_radius=max_var
b_theta=(450.-b_theta)*!DTOR

; Plot the lines here.
for i=0,n_elements(b_theta)-1 do $
  OPLOT,[0,b_radius],[0,b_theta[i]],/polar, _EXTRA=E_Base
endif

; +++++
; Plot the actual data here! Turn the winddirn into
; radians and offset it appropriately for plotting
; in compass coordinate system (North-Sount, East-West).
linestyle = keyword_set(linestyle) ? linestyle : 0
thick = keyword_set(thick) ? thick : 4
color = keyword_set(color) ? color : 0

OPLOT, var, (450.-wind_dirn)*!DTOR, /polar, $
linestyle=linestyle, thick=thick, color=color

; +++++

END

```

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