
Subject: Re: vector plots on maps

Posted by [Andy Lougher](#) on Wed, 04 Feb 1998 08:00:00 GMT

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> is there a routine by which I can overplot a vector field on a map?

I wrote this, but don't use it much. Have fun...

;This "front end" procedure is a help tool for map_vec.

```
pro vec_help
```

```
base = widget_base(title='VEC_HELP', /row)
list = widget_text(base, xsize=85, ysize=20 ,scroll=1, $
font='-adobe-helvetica-medium-r-normal--14-140-75-75-p-77-is o8859-1', $
      value=[$
'=====', $
'          >>> MAP_VEC HELP
MENU <<<', $
'', $
'          The map_vec procedure plots vectors within an existing
plot space.', $
'          Usually a map is produced, then vectors are overlayed
using velovect.', $
'', $
'-----', $
'USAGE:   map_vec, u, v, x, y, missing=missing, length=length,
maxvec=maxvec, round=round, $', $
'          dots=dots, color=color, everyx=everyx,
everyyy=everyyy, arrowsize=arrowsize, $', $
'          limit=limit, refvec=refvec, refunit=refunit,
refposx=refposx, $,$
'          refposy=refposy, reflabely=reflabely,
charsize=charsize, help=help', $
'=====', $
'', $
'PARAMETERS:', $
'    u,v..... 2-D data arrays specifying the zonal and
meridional velocity components.', $
'    x,y..... Meridional and zonal location vectors
(longitude, latitude).', $
'', $
'KEYWORDS:', $
'    missing..... Do not plot vectors with a magnitude greater or
equal to this value.', $
'    length..... Length factor. The default of 1.0 makes the
```

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longest vector the', $
'      length of one grid cell.', $
'      maxvec..... Maximum vector magnitude for scaling. Default
is computed', $
'      round..... Round computed maxvec so it is divisible by 5.', $
$      dots..... After setting dots to 1, a dot is placed at
missing data points.', $
'      color..... Color index for drawing vectors. Default is
zero.', $
'      everyx..... Plot every 2nd, 3rd, 4th... vector in the x
direction. Default is 1.', $
'      everyy..... Plot every 2nd, 3rd, 4th... vector in the y
direction. Default is 1.', $
'      arrowsize..... Factor by which default arrowsize is
multiplied.', $
'      limit..... vector containing [latmin, lonmin, latmx,
lonmax] for plotting area.', $
'', $
'      refvec..... After setting refvec to 1, a "max vector
magnitude" arrow appears on the plot.', $
"      refunit..... String variable containing unit of the reference
vector. Default is 'm s!U-1!n.", $
'      refposx..... Ending x position (in data coords.) for drawing
refvec. Default is computed.', $
'      refposy..... Y position (in data coords.) for drawing
refvec. Default is computed.', $
'      reflabely..... Y position (in data coords.) for drawing label
beneath refvec. Default is computed.', $
'      charsize..... Character size for reference vector label.
Default is .78', $
'      help..... Bring up this help menu.', $
'.....'+$'
'.....'+$'
'$'
'', $
'      EXAMPLE: Plotting global taux, tauy data.', $
"          taux = rz('/data/obs/nmc/stress/taux_9_90', xloc=x,
yloc=y)", $
"          tauy = rz('/data/obs/nmc/stress/tauy_9_90')", $
'          gplot, taux, x, y, /nodata ... or ... map_set, 0,
180, /cont, /cyl', $
'', $
'          map_vec, taux, tauy, x, y, missing=999., everyx=2,
everyyy=1, length=5, /dots, $', $
"          /refvec, refunit='dynes cm !e-2!n',
refposx=340., refposy=-100., $", $
'          reflabely=-106.', $

```

```

''])
```

widget_control, /realize, base

end

pro map_vec, u, v, x, y, missing=missing, length=length, maxvec=maxvec,
 round=round, \$
 dots=dots, color=color, everyx=everyx, everyy=everyy,
 arrowsize=arrowsize, \$
 limit=limit, refvec=refvec, refunit=refunit, refposx=refposx,
 refposy=refposy, \$
 reflabely=reflabely, charsize=charsize, help=help
 ;
 ; NAME:
 ; MAP_VEC
 ;
 ;
 ;
 ; PURPOSE:
 ; Produce a two-dimensional velocity field plot.
 ;
 ; A directed arrow is drawn at each point showing the direction and
 ; magnitude of the field.
 ;
 ;
 ;
 ; CATEGORY:
 ; Plotting, two-dimensional.
 ;
 ;
 ;
 ; CALLING SEQUENCE:
 ; MAP_VEC, U, V, X, Y
 ;
 ;
 ;
 ; INPUTS:
 ; U: The X component of the two-dimensional field.
 ; U must be a two-dimensional array.
 ;
 ; V: The Y component of the two dimensional field. Y must have
 ; the same dimensions as X. The vector at point (i,j) has a
 ; magnitude of:
 ;
 ; SQRT (U(i,j)^2 + V(i,j)^2)
 ;
 ; and a direction of:
 ;
 ; ATAN2 (V(i,j), U(i,j))
 ;

```
; ; OPTIONAL INPUT PARAMETERS:  
; X: Optional abcissae values. X must be a vector with a length  
; equal to the first dimension of U and V.  
;  
; Y: Optional ordinate values. Y must be a vector with a length  
; equal to the first dimension of U and V.  
;  
;  
; KEYWORD INPUT PARAMETERS:  
;   MISSING: Missing data value. Vectors with a LENGTH greater  
; than MISSING are ignored.  
;  
;   LENGTH: Length factor. The default of 1.0 makes the longest  
(U,V)  
; vector the length of a cell.  
;  
;   DOTS: Set this keyword to 1 to place a dot at each missing  
point.  
; Set this keyword to 0 or omit it to draw nothing for missing  
; points. Has effect only if MISSING is specified.  
;  
; COLOR: The color index used for the arrows.  
;  
;   EVERY: Plot every ____ vector. Default is 1.  
;  
; REFARROW: Plot a maximum vector magnitude. Default is 0 (NO).  
;  
; REFUNIT: Unit of max arrow. Default is m s!e-1!n (i.e., m/s)  
;  
; REFPOSX: X starting position of maxxarrow. Default is computed.  
;  
; REFPOSY: Y position of maxxarrow. Default is computed.  
;  
; REFLABELY: Y position of refveclabel. Default is computed.  
;  
;  
; OUTPUTS:  
; None.  
;  
;  
; COMMON BLOCKS:  
; None.  
;  
;  
; SIDE EFFECTS:  
; Plotting on the selected device is performed.  
;
```

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;
; RESTRICTIONS:
; None.
;
;
;
; PROCEDURE:
; Straightforward. The system variables !XTITLE, !YTITLE and
; !MTITLE can be set to title the axes.
;
;
;
; MODIFICATION HISTORY:
; DMS, RSI, Oct., 1983.
;
; For Sun, DMS, RSI, April, 1989.
;
; Added TITLE, Oct, 1990.
;
; Added POSITION, NOERASE, COLOR, Feb 91, RES.
;
;      Added all keywords past color.      June 1993, Andrew F.
Loughe
;      Draw to current plot area (usually a map).

```

```

on_error, 2          ;Return to caller if an error occurs
help = keyword_set(help)
if (help eq 1 or n_params() eq 0) then begin
  vec_help
  message, 'Stopped for help in map_vec.pro'
endif

s = size(u)
t = size(v)

; Check size of input arrays.

if n_params(1) lt 4 then $
  message, 'Must specify u, v, x, y'

  if s(0) ne 2 then begin
baduv:  message, 'U and V parameters must be 2D and same size.'
  endif

  if total(abs(s(0:2)-t(0:2))) ne 0 then goto, baduv

  if (n_elements(x) ne s(1) or n_elements(y) ne s(2)) then $
    message, 'X and Y arrays have incorrect size.'

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; Set some default values.
if n_elements(missing) le 0 then missing = 1.0e10
if n_elements(length) le 0 then length = 1.0
if n_elements(maxvec) le 0 then maxvec = -1.
if n_elements(round) le 0 then round = 0
if n_elements(everyx) le 0 then everyx = 1
if n_elements(everyy) le 0 then everyy = 1
if n_elements(arrowsize) le 0 then arrowsize = 1.
if n_elements(limit) le 0 then limit =
[-100.,-10000.,100.,10000.]
if n_elements(title) le 0 then title = "
if n_elements(charsize) le 0 then charsize = .78
if n_elements(color) le 0 then color = 0

latmin = limit(0)      ;Get geographical limits
lonmin = limit(1)      ;for plotting the data
latmax = limit(2)
lonmax = limit(3)

mag = sqrt(u^2 + v^2)   ;Get magnitude of all vectors

; Get subscripts of good and bad elements.
; good = those points where vector magnitude is less than missing value.
; bad = those points where vector magnitude is greater or equal to
missing value.
nbad = 0                 ;# of missing points
if n_elements(missing) gt 0 then begin
    good = where(mag lt missing)
    if keyword_set(dots) then bad = where(mag ge missing, nbad)
endif else begin
    good = lindgen(n_elements(mag))
endifelse

; Using good points, find maximum vector magnitude for scaling.
if (maxvec eq -1.) then begin
    mag2 = mag(good)           ;Get magnitude of good points.
    if (max(mag2) le 2) then maxvec = fix(max(mag2))
    if (max(mag2) gt 2) then maxvec = fix(max(mag2)+1)
    if (round eq 1) then begin
        maxvec = fix((max(mag2)+1)/5) * 5 ;Round maxvec down to
number divisible by 5
        print, 'Max vector length for scaling is made divisible by
5: ',maxvec
    endif
    if (maxvec eq 0.) then maxvec = 1
endif

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;Grid spacing needed for scaling vectors
    deltax = (max(x) - min(x)) / (s(1)-1)
    deltay = (max(y) - min(y)) / (s(2)-1)

; Plot vectors and arrow heads (loop through all points).
    for j = 0, s(2)-2, fix(everyy) do begin
        for i = 0, s(1)-1, fix(everyx) do begin

; Get scaled vector components.
; length = If three, the longest vector covers three grid cells.
; u,v = The actual velocity components.
; maxvec = The maximum wind component.

        if (mag(i,j) lt missing) then begin
            dx = length * (deltax) * (u(i,j)/maxvec) ;Get (u,v)
components
            dy = length * (deltay) * (v(i,j)/maxvec) ;that will be
plotted

            x0 = x(i) ;Get beginning/ending coords of vector
            x1 = x0 + dx
            y0 = y(j)
            y1 = y0 + dy

            if (y0 ge latmin and y1 le latmax and $
                x0 ge lonmin and x1 le lonmax) then
begin

hsize=float(arrowsize)*(!d.x_size/100.)*(mag(i,j)/(2.*maxvec ))
            arrow_andy, x0, y0, x1, y1, color=color, /data,
hsize=hszie
            endif
            endif
        endfor
    endfor

; Plot a "maximum vector" arrow at the bottom righthand corner of the
plot
    if n_elements(refvec) gt 0 then begin

; Determine new arrow head size and angle for the reference vector
        r = .4 ;Length of arrow head
        angle = 20. * !dtor ;Half-co-angle of arrowhead
        st = r * sin(angle) ;Sin 20 degs * length of head
        ct = r * cos(angle)

        dx = length * deltax ;Get x-component

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dy = length * deltay ;Get y-component
dy=0

; Compute (or use supplied value) for the ending x position, and the
; y position of the reference vector.
if n_elements (refposx) le 0 then refposx= max(x) - dx*3.
if n_elements (refposy) le 0 then refposy= min(y) -
(y(3)-y(0))

x0 = refposx - dx
y0 = refposy
x1 = x0 + dx
y1 = y0 + dy ;No y variation (reference vector is
horizontal)

; Find default (x,y) positions for max vector label
 xlabel = (x0 + x1)/2.
 ylabel = y0 - (y(4)-y(0))
 if n_elements(reflabely) gt 0 then ylabel=reflabely

; Determine (or use supplied value) unit of the reference vector
 if n_elements(refunit) le 0 then refunit= 'm s!U-1!n'

 max_label = strcompress(string(maxvec), /remove_all) ;Get
maxvec
 reftitle = max_label + ' ' + refunit
; xyouts, xlabel, ylabel, reftitle, align=.5,
charsize=charsize, color=color

; Found it more universally acceptable to plot refvec in normalized
coords.
 new_coords = convert_coord (x0, y0, /data, /to_norm)
 xx0 = new_coords(0) & yy0 = new_coords(1) ;refvec starts
here

 new_coords = convert_coord (x1, y1, /data, /to_norm)
 xx1 = new_coords(0) & yy1 = new_coords(1) ;refvec ends
here

 new_coords = convert_coord ( x1-(ct*dx-st*dy),
y1-(ct*dy+st*dx),$ /data, /to_norm)
 xx2 = new_coords(0) & yy2 = new_coords(1) ;top arrowheads
end here

 new_coords = convert_coord ( x1-(ct*dx+st*dy),
y1-(ct*dy-st*dx),$
```

```

        /data, /to_norm)
xx3 = new_coords(0) & yy3 = new_coords(1) ;bot arrowheads
end here

yy1 = yy0
plots,[xx0, xx1, xx3, xx1, xx3], $
[yy0, yy1, yy3+2.* (yy1-yy3), yy1, yy3], color=color, $
thick=1., /norm

xyouts, .5*(xx0+xx1), yy0-.015, reftitle, align=.5,
charsize=charsize, color=color, /norm

endif

; Place dots at missing data points
if nbad gt 0 then $
    oplot, x(bad mod s(1)), y(bad/s(1)), psym=3,
color=color

end

```

.....

```

PRO ARROW_ANDY, x0, y0, x1, y1, HSIZE = hsize, COLOR = color, HTHICK =
hthick, $
THICK = thick, DATA = data, DEVICE = device, NORMALIZED = norm, $
SOLID = solid
;+
; NAME: ARROW
; PURPOSE: Draw a vector(s) with an arrow head
; CATEGORY: Graphics
; CALLING SEQUENCE:
; ARROW, x0, y0, x1, y1
; INPUTS:
; (x0, y0) = coordinates of beginning of vector(s). May be arrays
; or scalars. Coordinates are in DEVICE coordinates
; unless otherwise specified.
; (x1, y1) = coordinates of endpoint (head) of vector.
; x0, y0, x1, y1 must all have the same number of elements.
; KEYWORD PARAMETERS:
; DATA - if set, implies that coordinates are in data coords.
; NORMALIZED - if set, coordinates are specified in normalized coords.
; HSIZE = size of arrowhead. Default = 1/64th the width of the device,
; (!D.X_SIZE / 64.).
; If the size is positive, it is assumed to be in device
; coordinate units. If it is NEGATIVE, then the head length
; is set to the vector length * abs(hsize), giving heads

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; proportional in size to the bodies. The size is defined as
; the length of each of the lines (separated by 60 degrees)
; that make the head.
; COLOR = drawing color. Default = highest color index.
; HTHICK = thickness of heads. Default = 1.0.
; SOLID = if set, make a solid arrow, using polygon fills, looks better
; for thick arrows.
; THICK = thickness of body. Default = 1.0.
;
;
; OUTPUTS:
; No explicit outputs.
; SIDE EFFECTS:
; RESTRICTIONS:
; PROCEDURE:
; Straightforward.
; Examples:
;   Draw an arrow from (100,150) to (300,350) in DEVICE units.
; ARROW, 100, 150, 300, 350
;
; Draw a sine wave with arrows from the line Y=0 to
; sin(x/4).
; X = FINDGEN(50)
; Y = SIN(x/4) ;Make sin wave
; PLOT, X, Y
; ARROW, X, REPLICATE(0,50), X, Y, /DATA
; MODIFICATION HISTORY:
; DMS, Feb, 1992.
; DMS, Sept, 1992. Added /SOLID.
;-

```

; Draw an arrow with a head from (x0,y0) to (x1, y1). Params may be
; vectors.

; Set up keyword params

```
if n_elements(thick) eq 0 then thick = 1.
if n_elements(hthick) eq 0 then hthick = thick
```

```
;Head size in device units
if n_elements(hsize) eq 0 then arrowsize = !d.x_size/64. * (hthick/2. >
1) $
  else arrowsize = float(hsize)
if n_elements(color) eq 0 then color = !P.color
```

angle = 20.0 ;degrees for head angle

```
mcost = - cos( !dtor * angle )
sint = sin( !dtor * angle )
```

```

msint = - sint

for i = 0, n_elements(x0)-1 do begin ;Each vector
if keyword_set(data) then $ ;Convert?
  p = convert_coord([x0(i),x1(i)],[y0(i),y1(i)], /data, /to_dev) $
else if keyword_set(norm) then $
  p = convert_coord([x0(i),x1(i)],[y0(i),y1(i)], /norm, /to_dev) $
else p = [[x0(i), y0(i)],[x1(i), y1(i)]]


xp0 = p(0,0)
xp1 = p(0,1)
yp0 = p(1,0)
yp1 = p(1,1)

dx = float(xp1-xp0)
dy = float(yp1-yp0)
zz = sqrt(dx^2 + dy^2) ;Length

if zz gt 1e-6 then begin
  dx = dx/zz ;Cos th
  dy = dy/zz ;Sin th
endif else begin
  dx = 1.
  dy = 0.
  zz = 1.
endelse
if arrowsize gt 0 then a = arrowsize $ ;a = length of head
else a = -zz * arrowsize

xxp0 = xp1 + a * (dx*mcost - dy * msint)
ypy0 = yp1 + a * (dx*msint + dy * mcost)
xxp1 = xp1 + a * (dx*mcost - dy * sint)
ypy1 = yp1 + a * (dx*sint + dy * mcost)

;print, xxp0, ypy0, xxp1, ypy1
;if ( ( (xp0 le 900) and (yp0 le 900) and (xp1 le 900) and (yp1 le 900)
) $
;then begin

if keyword_set(solid) then begin ;Use polyfill?
  b = a * mcost*.9 ;End of arrow shaft (Fudge to force join)
  plots, [xp0, xp1+b*dx], [yp0, yp1+b*dy], /DEVICE, $
  COLOR = color, THICK = thick
  polyfill, [xxp0, xxp1, xp1, xxp0], [ypy0, ypy1, yp1, ypy0], $
  /DEVICE, COLOR = color

endif else begin

```

```
plots, [xp0, xp1], [yp0, yp1], /DEVICE, COLOR = color, THICK = thick,  
$  
    noclip=0  
plots, [xxp0,xp1,xxp1],[ypy0,yp1,ypy1], /DEVICE, COLOR = color, $  
    THICK = hthick, noclip=0  
endelse  
  
;endif  
  
ENDFOR  
  
end
```
