Introduction to NCL Graphics

Paneling Plots

Part IV in the series

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http://www.ncl.ucar.edu/Training/Webinars/NCL_Graphics/PanelDemo/

NCL Home Page -> Intro to NCL Graphics Webinars -> Webinar #4

Introduction to NCL Graphics
About this series

• Fourth in a series:
  – The basics and XY plots
  – Creating contours plots
  – Vector plots and overlays
  – Panel plots
  – Primitives

• Webinars are expanded versions of NCL workshop lectures . . . with more time for demos!

• To see other webinars in this series:

  http://www.ncl.ucar.edu/Training/Webinars/NCL_Graphics/
My goals

• Get you comfortable with creating NCL graphics . . . won’t make you an expert!

• Sneak in tips for more advanced users

• Answer your burning questions
Assumptions

Familiar with:

- basic NCL language features
- NCL array syntax
- reading data off a NetCDF file using NCL
- basic structure of an NCL graphics script
- NCL/NetCDF data model
- UNIX
Outline

- Panel plot gallery
- Three ways to panel plots
- Line-by-line scripts
- Demo
- Tips
Panel plot gallery

Many images are from the “panels” example page

NCL Home Page -> Examples

Browser search for “panel”

http://www.ncl.ucar.edu/Applications/panel.shtml
Panel plots – multiple plots on a page


Variation of T(0) with Heating Location and Rossby Radius

Temperature Tendency at Vortex Center (K h⁻¹)

1995-1999: May to Oct
ESMF Regridding

Original EASE grid (721,721)

Regridded to 0.25 deg grid (359 x 1439)
Maps with filled and transparent bars
OLR file from Bob Setzenfand
The "Alaska Essential Fish Habitat Species" shapefile was downloaded from:

http://alaskafisheries.noaa.gov/habitat/efh/efhshp/default.htm
panels with a specially created labelbar
Two panel plots in one
Outline

• Panel plot gallery
• Three ways to panel plots
  • Line-by-line scripts
  • Demo
• Tips
Paneling plots with NCL – three methods

1. Using “gsn_panel” procedure

2. Setting `vpXF / vpYF / vpWidthF / vpHeightF` resources

3. Using “gsn_attach_plots” function

Note: `gsn_panel` uses method #2 “under the hood”
Plot created using “gsn_panel”
Plot created using vpXXXXXF resources

Courtesy Adam Phillips, NCAR CGD
Plot created using “gsn_attach_plots” and “gsn_panel”
Method 1: using “gsn_panel”

```
gsn_panel( wks, plots, (/n,m/), pres )
```

- **wks** is the workstation
- **plots** is a 1D array of plots to panel
- **(/n,m/)** is the configuration desired (rows x columns)
- Special case for third argument:
  - # of plots per row: **(/n1,n2,n3,.../)**
- **pres** is an optional resource list for customizing behavior of **gsn_panel**
gsn_panel specifics

• Plots should be same size, or very close!
• Plots are drawn from left-to-right, top-to-bottom
• Can have common title, labelbar, figure captions
• Can have multiple sets of panels on one page
Outline

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gsn_panel scripts

Scripts that follow are “slp1a.ncl” and “slp1b.ncl”

Data file also found here, “SLP.1979_2003.nc”

http://www.ncl.ucar.edu/Training/Webinars/NCL_Graphics/PanelDemo/
load "$/NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_code.ncl"
load "$/NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_csm.ncl"

;---Read “SLP” variable off NetCDF file
filename = "SLP.1979_2003.nc"
a = addfile(filename,"r")
slp = a->slp ; time x lat x lon (300 x 73 x 144)

;---Open an X11 window
wks = gsn_open_wks("x11","slp1a")

;---Set some plotting options
res = True
res@cnFillOn = True ; Turn on color fill

;---Create plots of first four time steps
plot0 = gsn_csm_contour_map(wks,slp(0,:,:,:),res)
plot1 = gsn_csm_contour_map(wks,slp(1,:,:,:),res)
plot2 = gsn_csm_contour_map(wks,slp(2,:,:,:),res)
plot3 = gsn_csm_contour_map(wks,slp(3,:,:,:),res)

;---Panel all four plots in a 2 x 2 configuration
pres = True
gsn_panel(wks, (/plot0,plot1,plot2,plot3/),(/2,2/),pres)
Same script, but with a “do loop”

;---Read “slp” variable off NetCDF file
filename = "SLP.1979_2003.nc"
a        = addfile(filename,"r")
slp      = a->slp ; 300 x 73 x 144

;---Open an X11 window
wks = gsn_open_wks("x11","slp1b")

;---Set some plotting options
res          = True
res@cnFillOn = True ; Turn on color fill

;---Loop across first four time steps and create a plot
nplots = 4
plots  = new(nplots,graphic) ; create array to hold plots
do i=0,nplots-1
   plots(i) = gsn_csm_contour_map(wks,slp(i,:,:),res)
end do

;---Panel all four plots in a 2 x 2 configuration
pres = True
gsn_panel(wks,plots,(/2,2/),pres)
Outline

- Panel plot gallery
- Three ways to panel plots
- Line-by-line script
- Demo
- Tips
Demo

Start with “slp1b.ncl” script from previous example

http://www.ncl.ucar.edu/Training/Webinars/NCL_Graphics/PanelDemo/
Outline

• Panel plot gallery
• Three ways to panel plots
• Line-by-line script
• Demo
• Tips
Method 2: setting “vpXXXXF” resources

• Use if plots are different sizes

• Use if you need more control over location and/or size of plots

• \texttt{vpXF} / \texttt{vpYF} / \texttt{vpWidthF} / \texttt{vpHeightF} are the resources you need

• Use “\texttt{drawNDCGrid}” to draw a handy “viewport” grid
Method 3: using "gsn_attach_plots"

Use if plots need to share a common axis

chi200_ud_smooth.nc

"panel_10.ncl" on panel examples page
Tips for debugging panels gone bad

- Plots are not the same size, so paneling doesn’t work
- Plots are going off the screen
;---Generate arrays to hold dummy data
  npts   = 50
  npplots = 6
  y      = new((/npplots,npts/),float)
  ybeg   = (/0.00001,-5, 100000, 0, 10, 100/) ; begin values
  yend   = (/1.00000, 5, 500000,20, 50, 200/) ; end values

  wks = gsn_open_wks("x11","panel_too_big")

  res       = True
  res@gsnDraw = False
  res@gsnFrame = False
  res@vpWidthF = 0.8 ; set width of plot
  res@vpHeightF = 0.3 ; set height of plot

;---Create dummy data and plots in same loop
  plot = new(npplots,graphic)
  do i=0,npplots-1
     y(i,:)  = random_uniform(ybeg(i),yend(i),npts)
     plot(i) = gsn_csm_y(wks,y(i,:),res)
  end do

;---Panel these plots
  pres = True
  gsn_panel(wks,plot,(/3,2/),pres)
What’s wrong with this set of plots?
;---Generate arrays to hold dummy data
npts   = 50
nplots = 6
y      = new((/nplots,npts/),float)
ybeg   = (/0.00001,-5, 100000, 0, 10, 100/)  ; begin values
yend   = (/1.00000, 5, 500000,20, 50, 200/)  ; end values

wks = gsn_open_wks("x11","panel_too_big")

res           = True
res@gsnDraw    = False
res@gsnFrame   = False
res@vpWidthF   = 0.8           ; set width of plot
res@vpHeightF  = 0.3           ; set height of plot

;---Create dummy data and plots in same loop
plot = new(nplots,graphic)
do i=0,nplots-1
   y(i,:)  = random_uniform(ybeg(i),yend(i),npts)
   plot(i) = gsn_csm_y(wks,y(i,:),res)
end do

;---Panel these plots
pres               = True
pres@gsnPanelBoxes = True    ; draws red boxes around each plot
gsn_panel(wks,plot,(/3,2/),pres)
;---Generate arrays to hold dummy data
npts  = 50
nplots = 6
y      = new((/nplots,npts/),float)
ybeg   = (/0.00001,-5, 100000, 0, 10, 100/) ; begin values
yend   = (/1.00000, 5, 500000,20, 50, 200/) ; end values

wks = gsn_open_wks("x11","panel_too_big")

res           = True
res@gsnDraw    = False
res@gsnFrame   = False
res@vpWidthF   = 0.8 ; set width of plot
res@vpHeightF  = 0.3 ; set height of plot

;---Create dummy data and plots in same loop
plot = new(nplots,graphic)
do i=0,nplots-1
   y(i,:)  = random_uniform(ybeg(i),yend(i),npts)
   plot(i) = gsn_csm_y(wks,y(i,:),res)
end do

;---Panel these plots
pres               = True
pres@gsnPanelScalePlotIndex = 2 ; base scaling on 3rd plot
gsn_panel(wks,plot,(/3,2/),pres)
gsnPanelScalePlotIndex

Useful when plots have different tickmarks

“panel_23.ncl” on panel examples page
Panel resources for debugging

- `res@gsnPanelScalePlotIndex = plot_index`
  - If one plot is larger than the others
- `res@gsnPanelDebug = True`
  - Prints debug information about size and location of paneled plots
- `res@gsnPanelBoxes = True`
  - Draws bounding boxes around each plot element so you can see true size
- `res@gsnPanelXF / res@gsnPanelYF`
  - Use these to force plots to line up
- `vpXF/vpYF/vpWidthF/vpHeightF`
  - If you need to abandon `gsn_panel`!
Multiple panels on one page

- Panels are drawn in a unit square
- By default:
  - \texttt{gsnPanelTop} = 1.0
  - \texttt{gsnPanelBottom} = 0.0
  - \texttt{gsnPanelLeft} = 0.0
  - \texttt{gsnPanelRight} = 1.0
- Can use these resources to restrict area for panels
Tip: NDC grid was drawn with drawNDCGrid

```
pres = True
pres@gsnFrame = False ; Don’t advance frame
pres@gsnPanelLabelBar = True

gsn_panel(wks,plot,(/2,1/),pres)
drawNDCGrid(wks) ; Draws an NDC grid
frame(wks) ; Now advance frame
```
pres = True
pres@gsnFrame = False
pres@gsnPanelLabelBar = True
pres@gsnPanelBottom = 0.5
gsn_panel(wks,plot,(/2,1/),pres)
pres                  = True
pres@gsnFrame        = False
pres@gsnPanelLabelBar = True
pres@gsnPanelLeft    = 0.5

gsn_panel(wks,plot,(/2,1/),pres)
;---Create two columns of panel plots
pres = True
pres@gsnFrame = False
pres@gsnPanelLabelBar = True

;---Left column
pres@gsnPanelLeft = 0.0
pres@gsnPanelRight = 0.5
gsn_panel(wks,plot(0::2),(/2,1/),pres)

;---Right column
pres@gsnPanelLeft = 0.5
pres@gsnPanelRight = 1.0
gsn_panel(wks,plot(1::2),(/2,1/),pres)

frame(wks)
;---Create one column of plots
pres                  = True
pres@gsnFrame        = False

;---Top 1/3 of NDC square
pres@gsnPanelTop     = 1.0
pres@gsnPanelBottom  = 0.6667
gsn_panel(wks,plot(0),(/1,1/),pres)

;---Bottom 2/3 of NDC square
pres@gsnPanelTop     = 0.6667
pres@gsnPanelBottom  = 0.0
gsn_panel(wks,plot(1:2),(/2,1/),pres)

;---Add the two custom labelbars
ncolors = dimsizes(res@cnLevels)+1
labels  = "" + res@cnLevels
colors1 = span_color_rgba(color_maps(0),ncolors)
colors2 = span_color_rgba(color_maps(1),ncolors)

lbres               = True
lbres@vpWidthF      = 0.2
lbres@vpHeightF     = 0.3
lbres@lbOrientation = "Vertical"
lbres@lbPerimOn     = False
lbres@lbLabelFontHeightF = 0.012
lbres@lbLabelAlignment = "InteriorEdges"
lbres@lbMonoFillPattern = True
lbres@lbFillColors  = colors1
gsn_labelbar_ndc (wks,ncolors,labels,0.79,0.99,lbres)

;---Change location, size, colors of second labelbar
lbres@vpHeightF     = 0.55
lbres@lbFillColors  = colors2
gsn_labelbar_ndc (wks,ncolors,labels,0.79,0.62,lbres)
frame(wks)
pres@gsnPanelRowSpec = True

gsn_panel(wks,plots,(/1,3,2,1/),pres
\texttt{pres@gsnPanelRowSpec} = \texttt{True} \\
\texttt{pres@gsnPanelCenter} = \texttt{False} \\
\texttt{gsn\_panel(wks,plots,(/1,3,2,1/),pres}
### Resources useful with `gsn_panel`

<table>
<thead>
<tr>
<th>Function/Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>gsnPanelLabelBar</code></td>
<td>Turn on panel labelbar</td>
</tr>
<tr>
<td><code>txString</code></td>
<td>Add title for paneled plots</td>
</tr>
<tr>
<td><code>gsnPanelFigureStrings</code></td>
<td>Add figure captions</td>
</tr>
<tr>
<td><code>gsnPanelScalePlotIndex</code></td>
<td>Index of plot to use for scaling all plots</td>
</tr>
<tr>
<td><code>gsnMaximize</code></td>
<td>Maximize paneled plots in frame</td>
</tr>
<tr>
<td><code>gsnPanelBottom</code> / <code>gsnPanelTop</code> / <code>gsnPanelLeft</code> / <code>gsnPanelRight</code></td>
<td>Control location of paneled plots in unit square</td>
</tr>
<tr>
<td><code>gsnPanelXWhiteSpacePercent</code> / <code>gsnPanelYWhiteSpacePercent</code></td>
<td>Control amount of white space between plots in a panel</td>
</tr>
</tbody>
</table>

### Functions / procedures useful with `gsn_panel`

<table>
<thead>
<tr>
<th>Function/Procedure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>gsn_create_labelbar</code></td>
<td>Create a custom labelbar</td>
</tr>
<tr>
<td><code>gsn_create_legend</code></td>
<td>Create a custom legend</td>
</tr>
<tr>
<td><code>gsn_legend_ndc</code></td>
<td>Draw a custom legend using NDC coordinates</td>
</tr>
<tr>
<td><code>gsn_labelbar_ndc</code></td>
<td>Draw a custom labelbar using NDC coordinates</td>
</tr>
<tr>
<td><code>drawNDCGrid</code></td>
<td>Draw NDC grid (for debugging purposes)</td>
</tr>
</tbody>
</table>
More advanced paneling

• See “panels” examples page:
  NCL Home Page -> Examples -> \textit{browser search} “panel”
  \url{http://www.ncl.ucar.edu/Applications/panel.shtml}

• See list of every example that “\texttt{gsn\_panel}” call appears in:
  NCL Home Page -> Examples
  \textit{[List of tips, resources, \texttt{functions/procedures}, and the examples they appear in.]}  
  \url{http://www.ncl.ucar.edu/Applications/func\_list.shtml}
Questions? ncl-talk@ucar.edu
http://mailman.ucar.edu/mailman/listinfo/ncl-talk

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