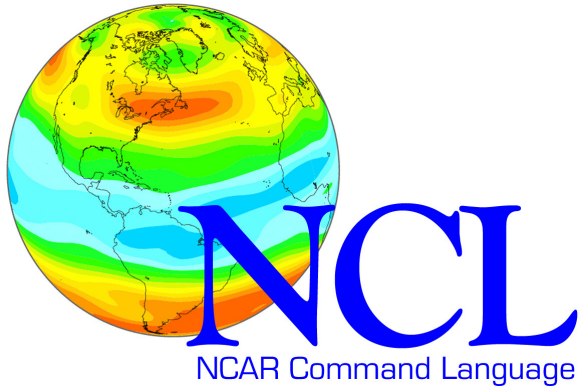
Introduction to NCL Graphics

Paneling Plots

Part IV in the series

November 18, 2014

Mary Haley



CISL NESL NCAR NATIONAL CENTER FOR ATMOSPHERIC RESEARCH NSF

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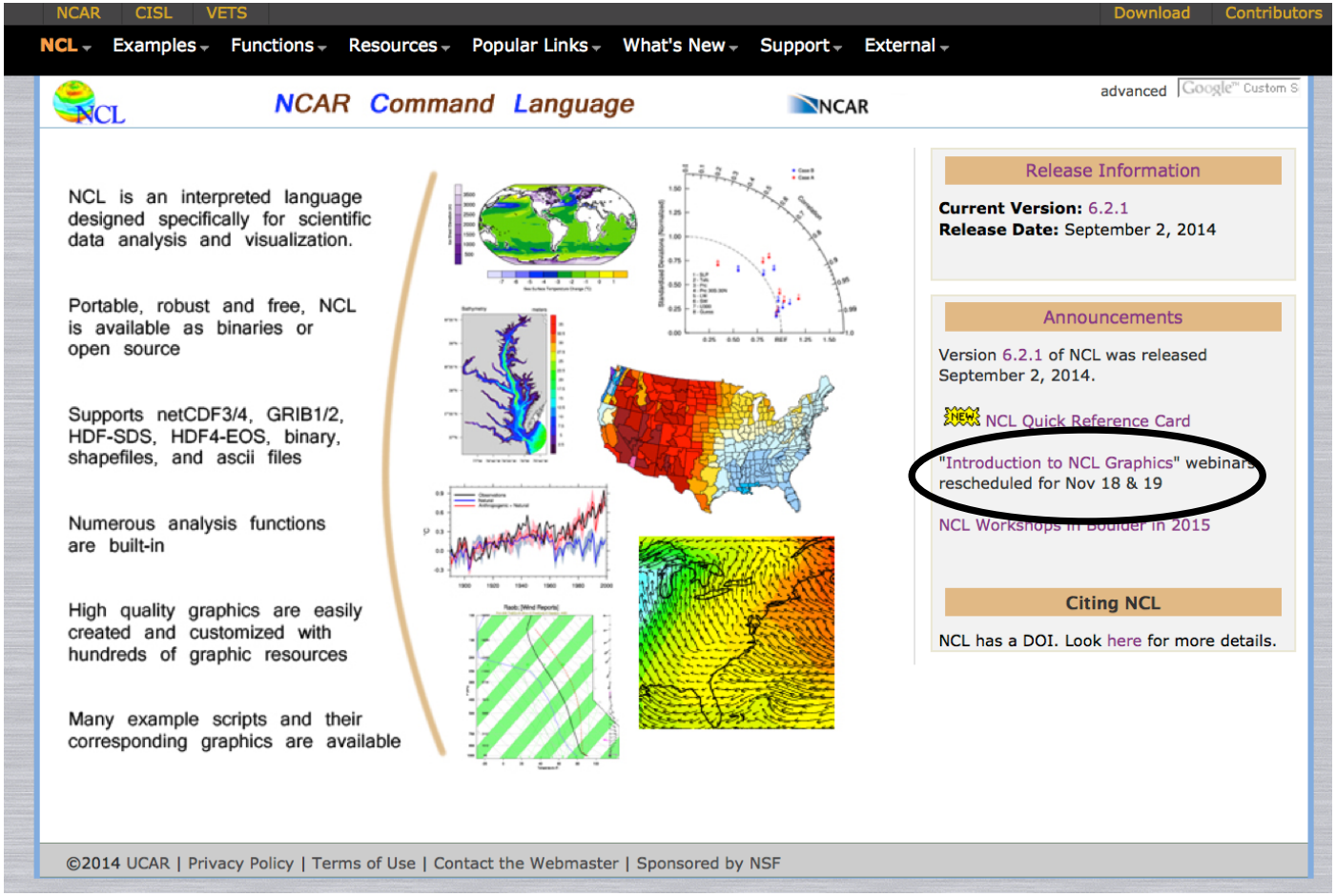
You may want to bookmark this link

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

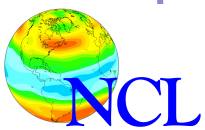
NCL Home Page -> Intro to NCL Graphics Webinars -> Webinar #4



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/



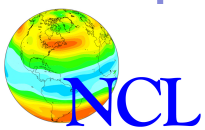
My goals

- 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

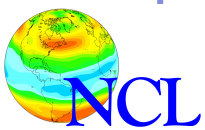
Familiar with:

- 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



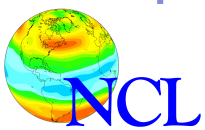
Panel plot gallery

Many images are from the “panels” example page

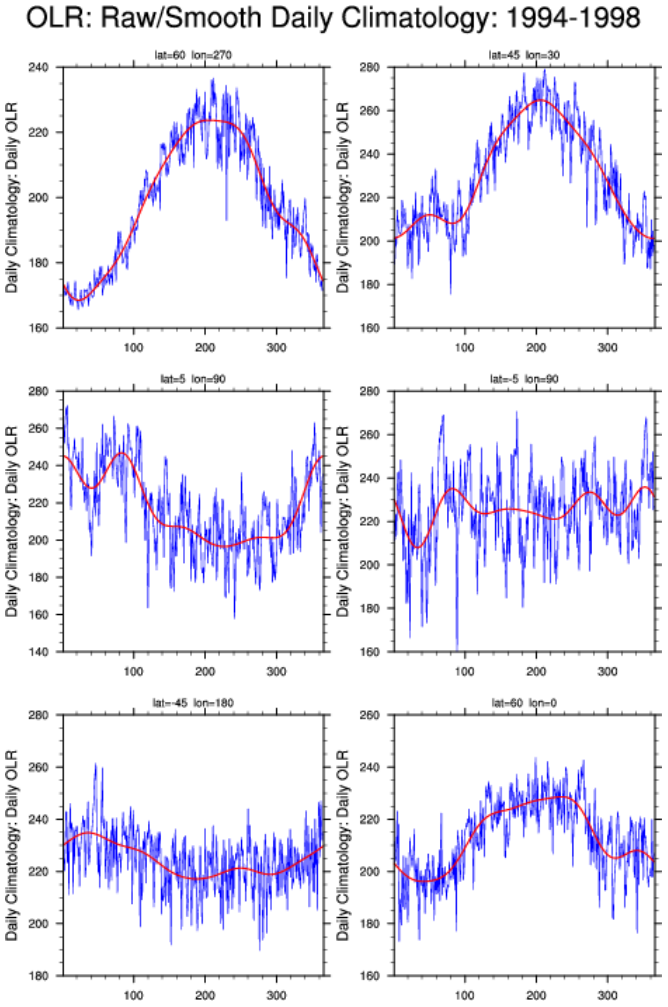
NCL Home Page -> Examples

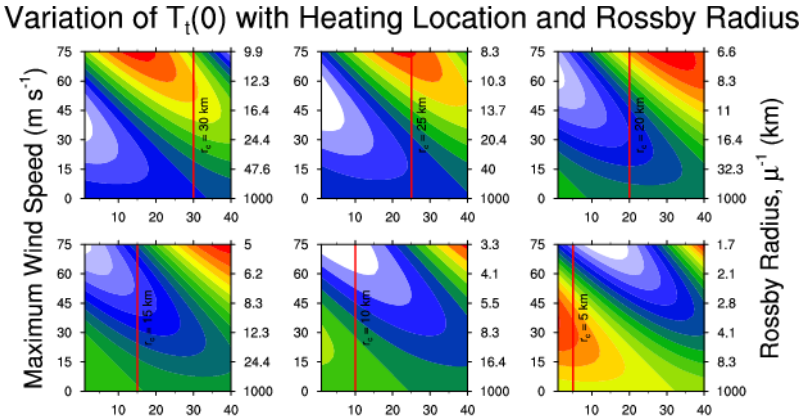
Browser search for “panel”

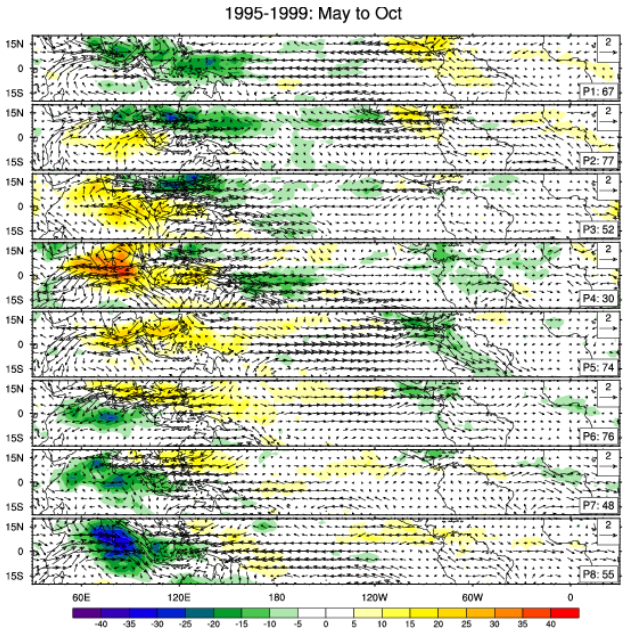
http://www.ncl.ucar.edu/Applications/panel.shtml

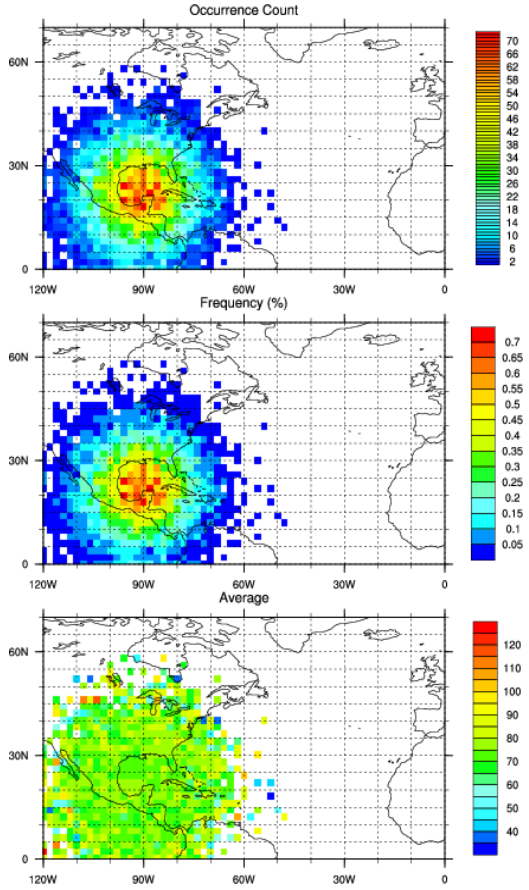


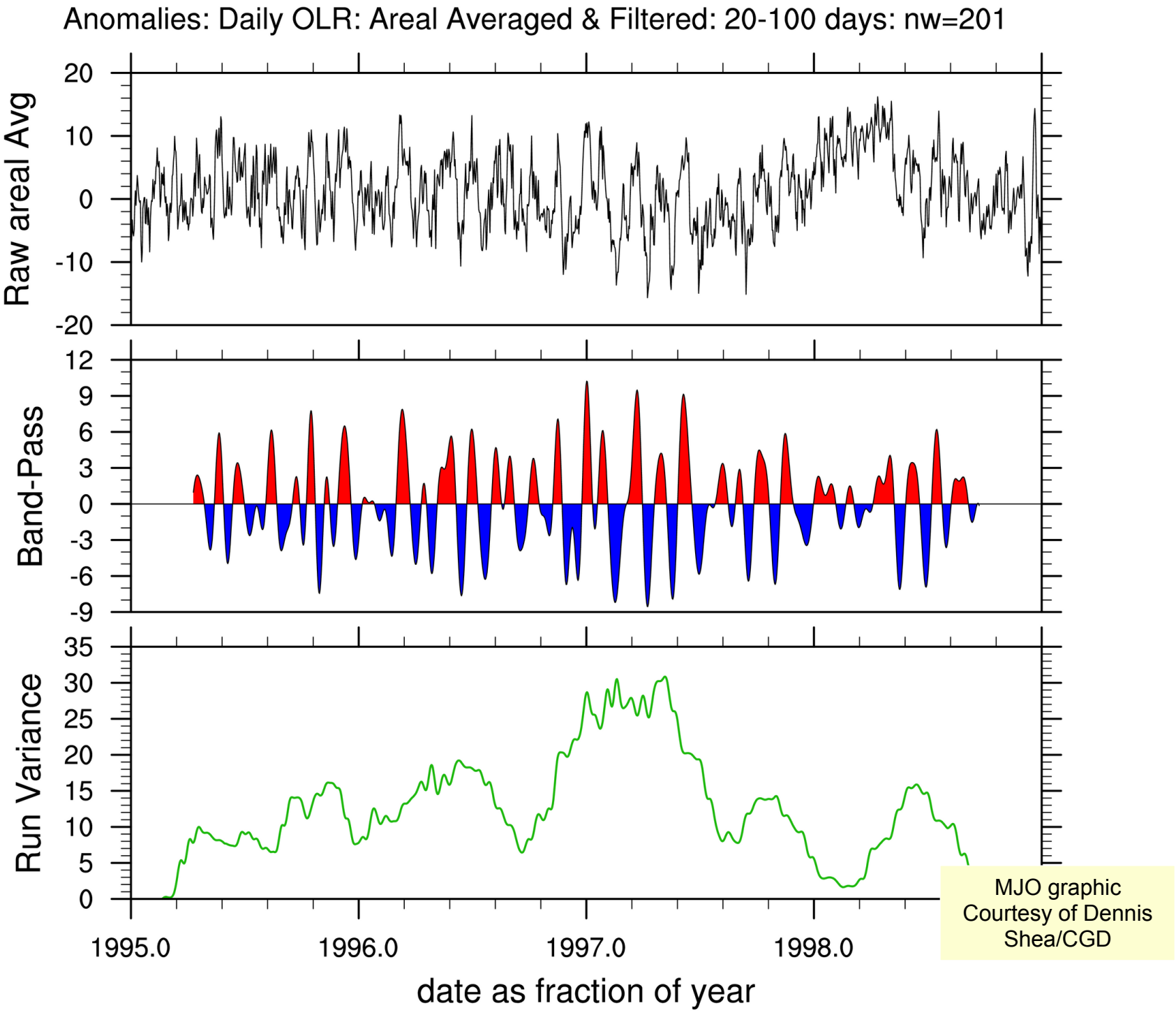
Panel plots – multiple plots on a page



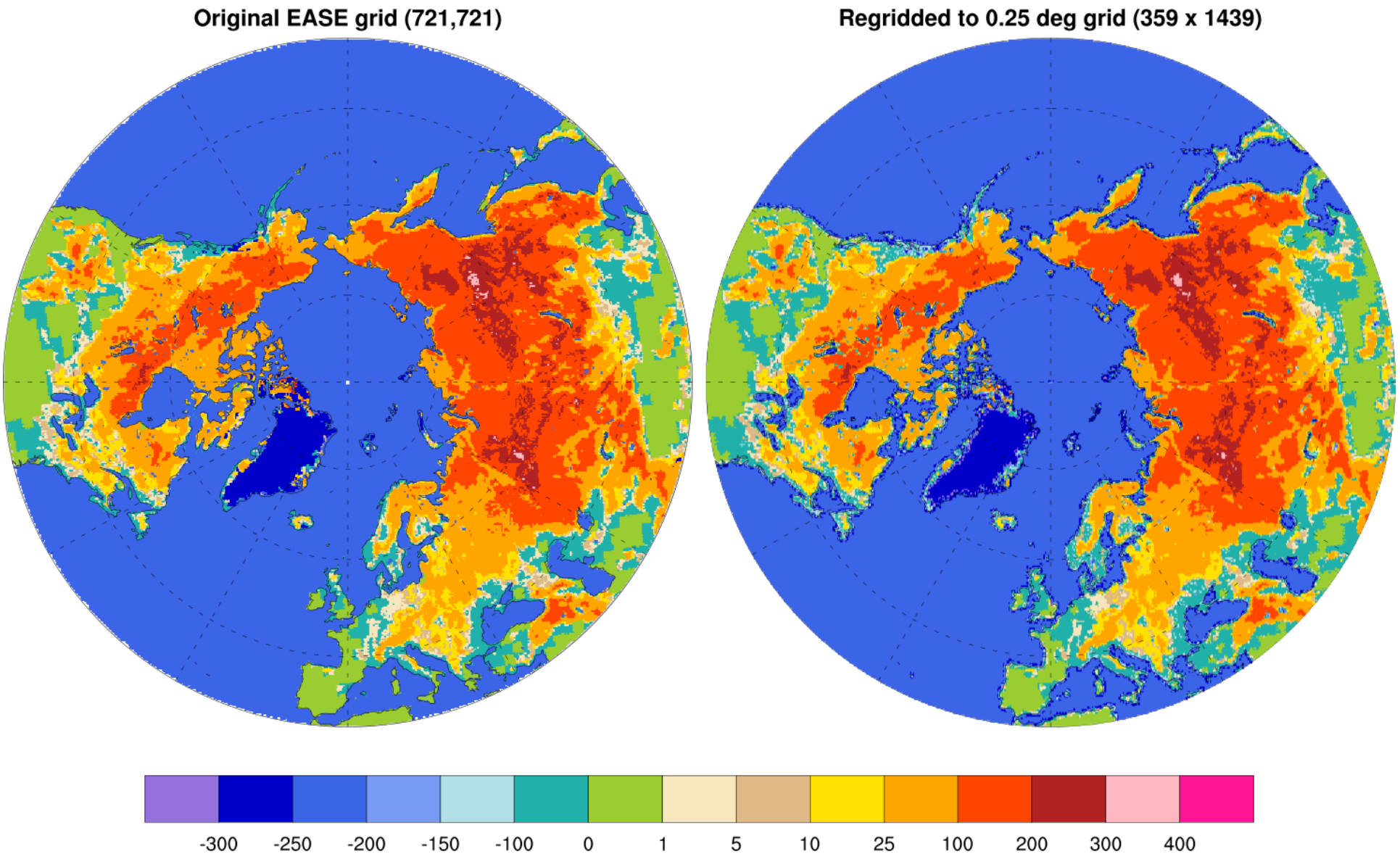




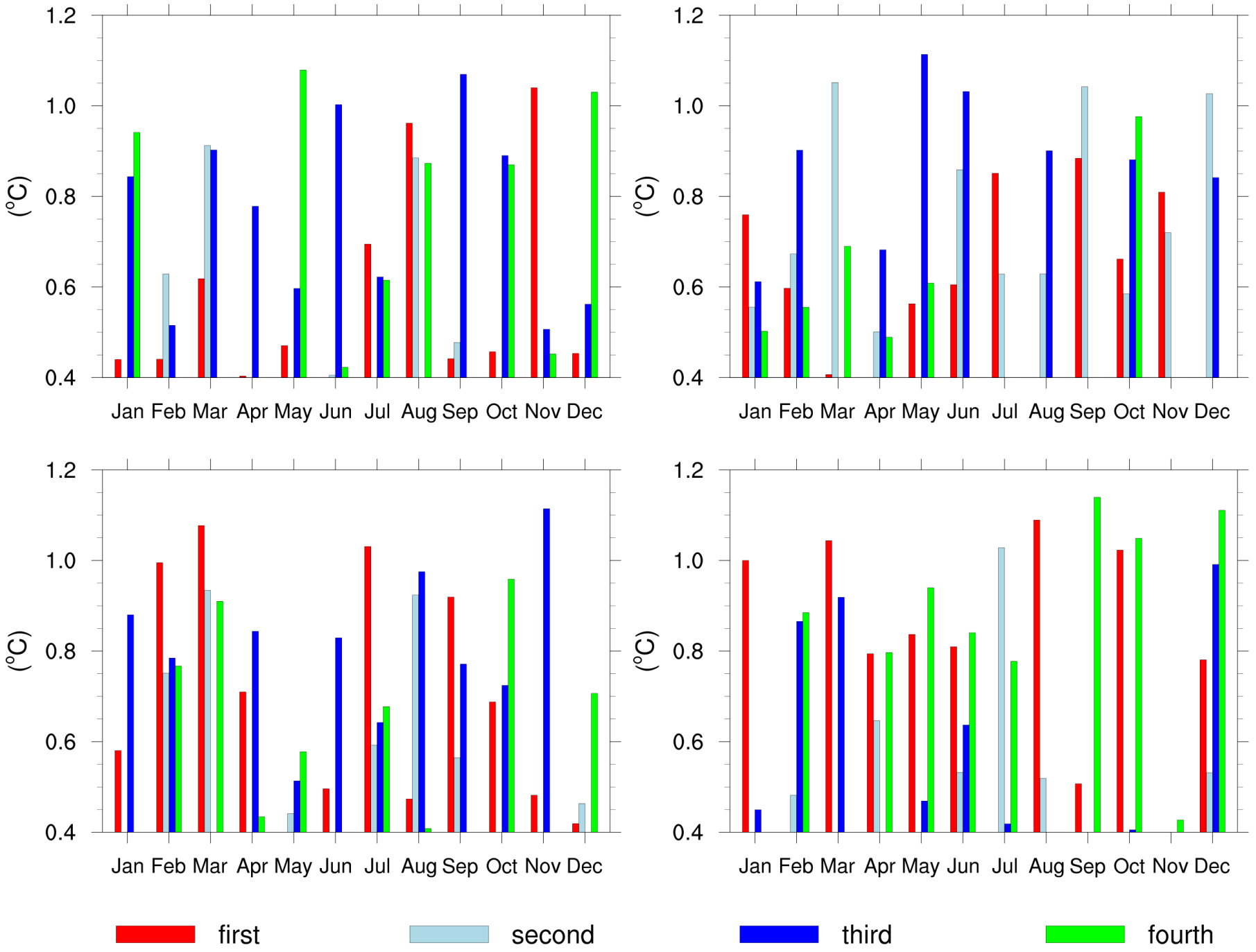



Anomalies: Daily OLR: Areal Averaged & Filtered: 20-100 days: nw=201
Raw areal Avg
20
10
0
-10
-20
Band-Pass
12
9
6
3
0
-3
-6
-9
Run Variance
35
30
25
20
15
10
5
0
1995.0
1996.0
1997.0
1998.0
date as fraction of year
MJO graphic
Courtesy of Dennis
Shea/CGD

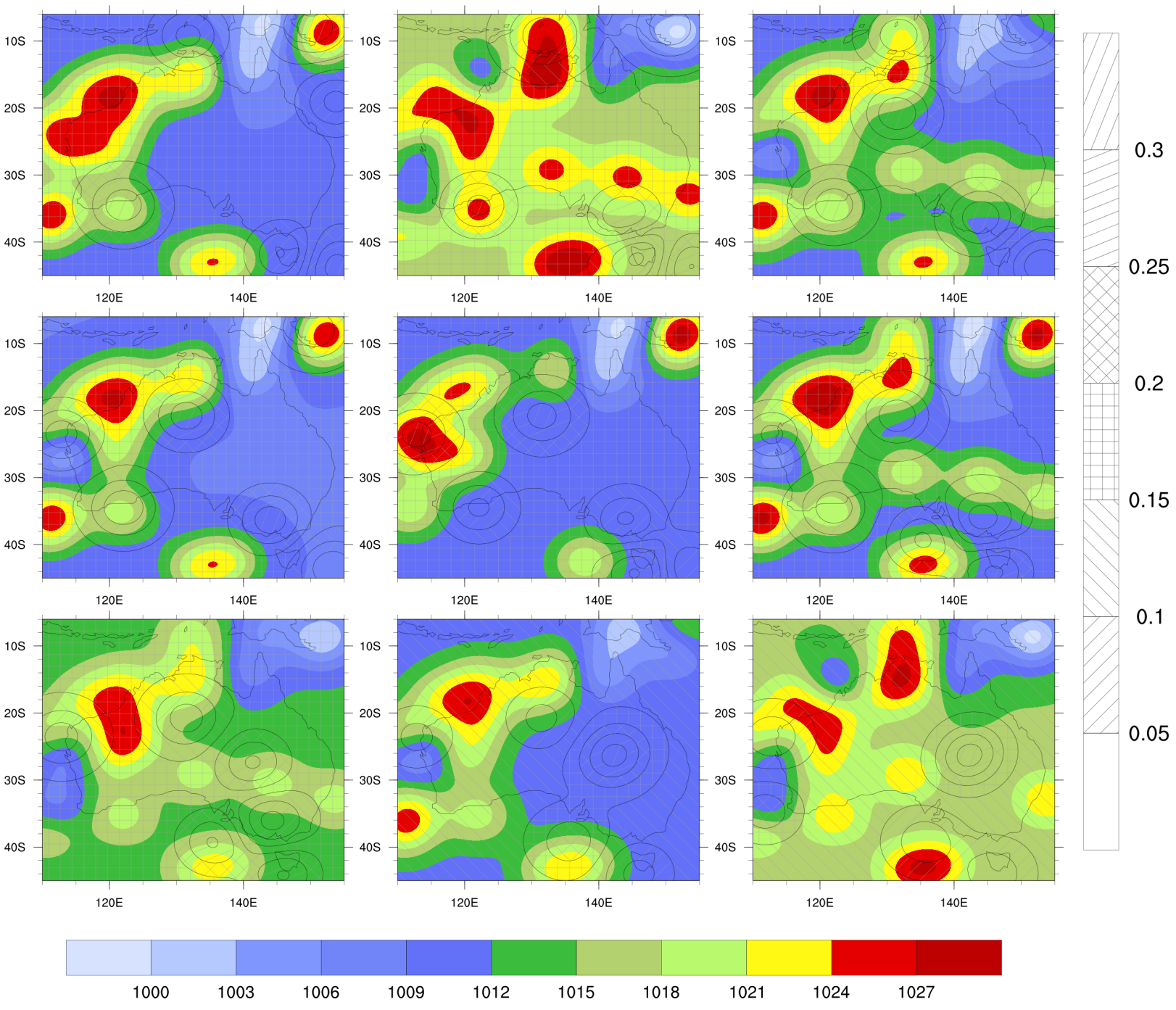
ESMF Regridding



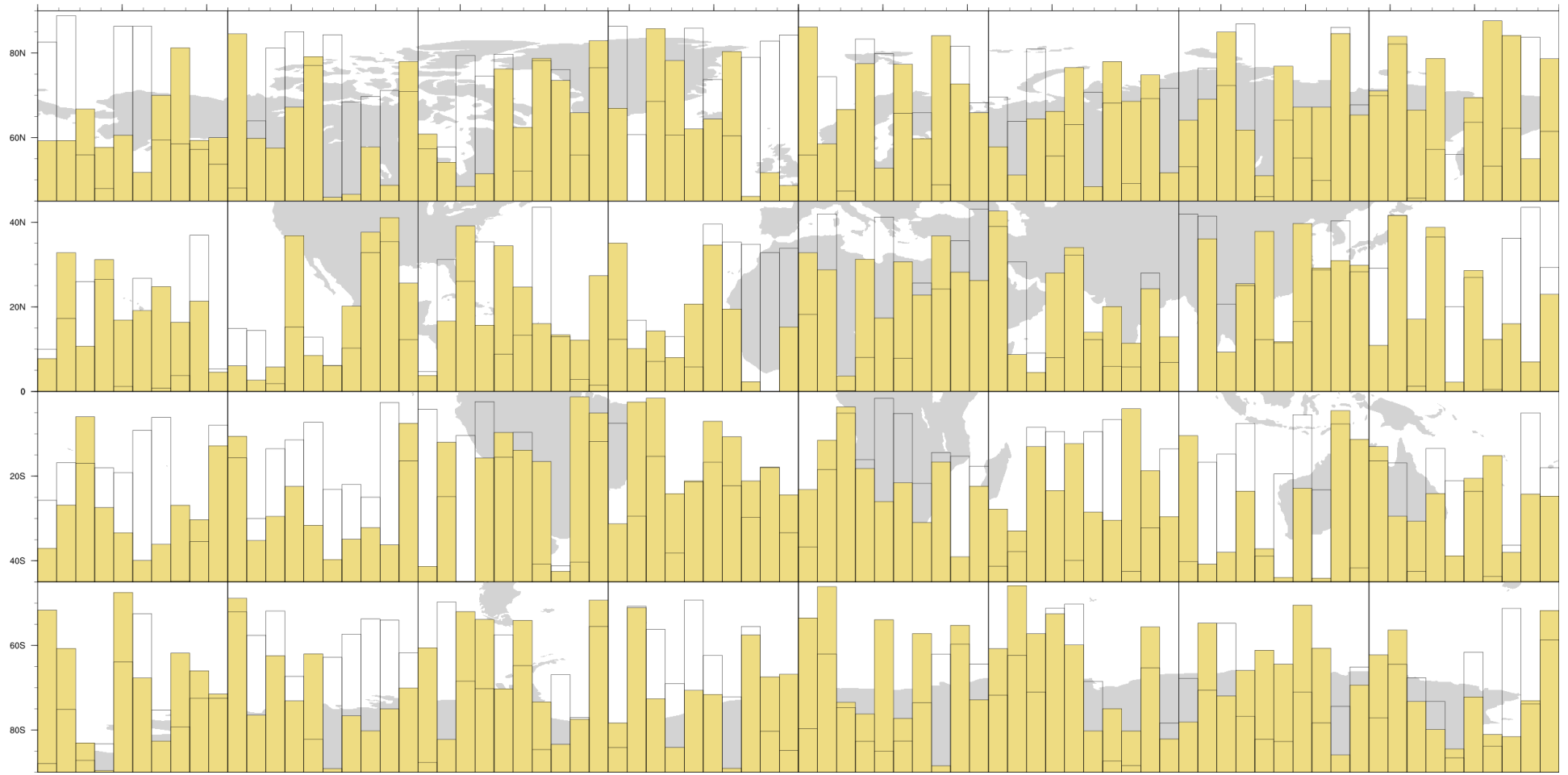
Paneling bar plots, dummy data



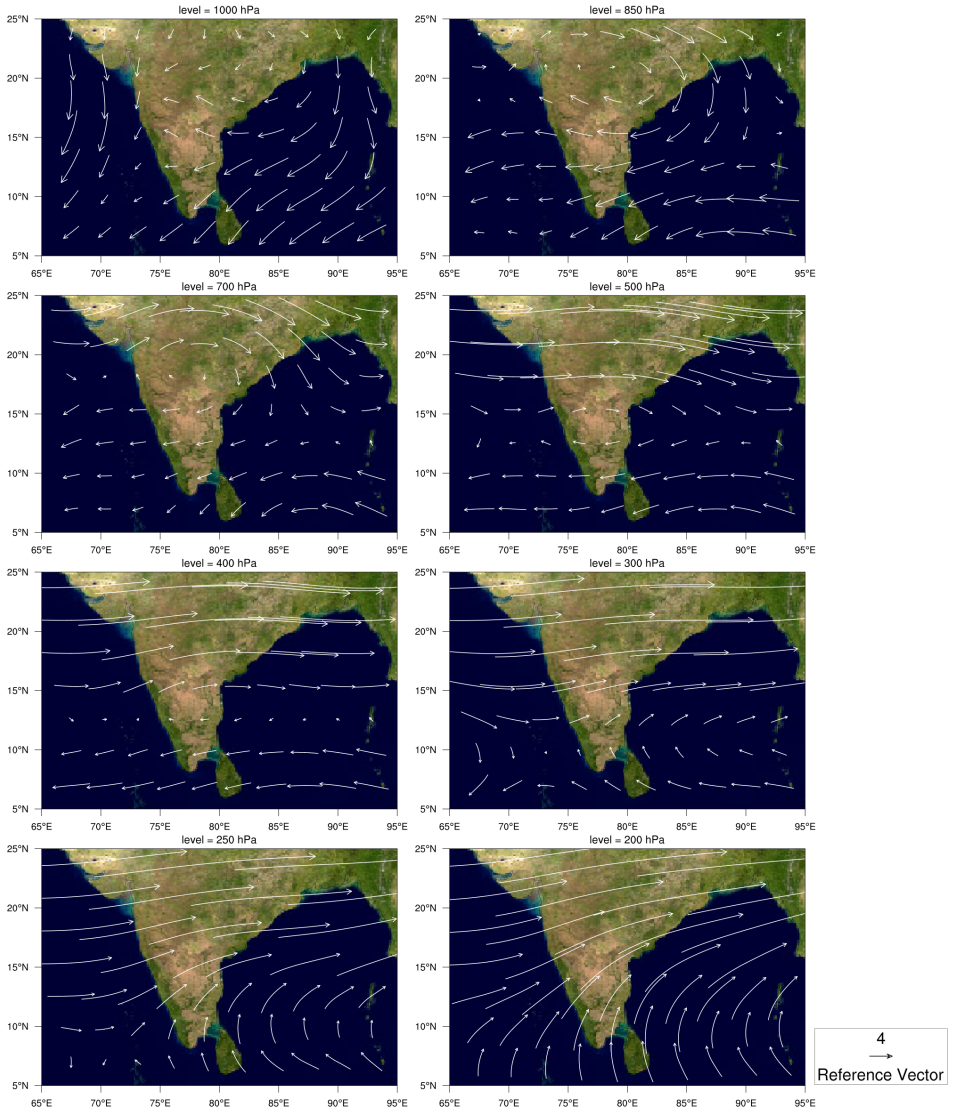
Panel plot with two labelbars



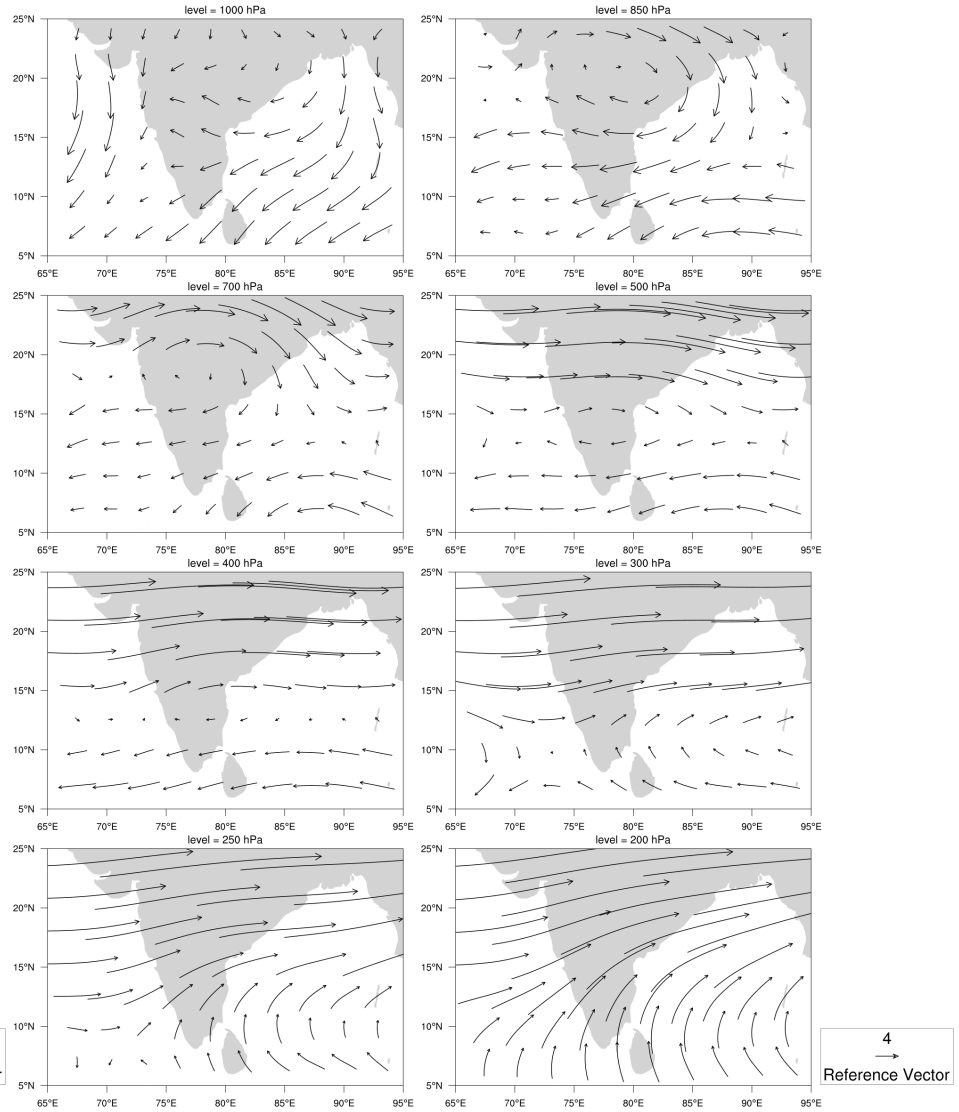
Maps with filled and transparent bars



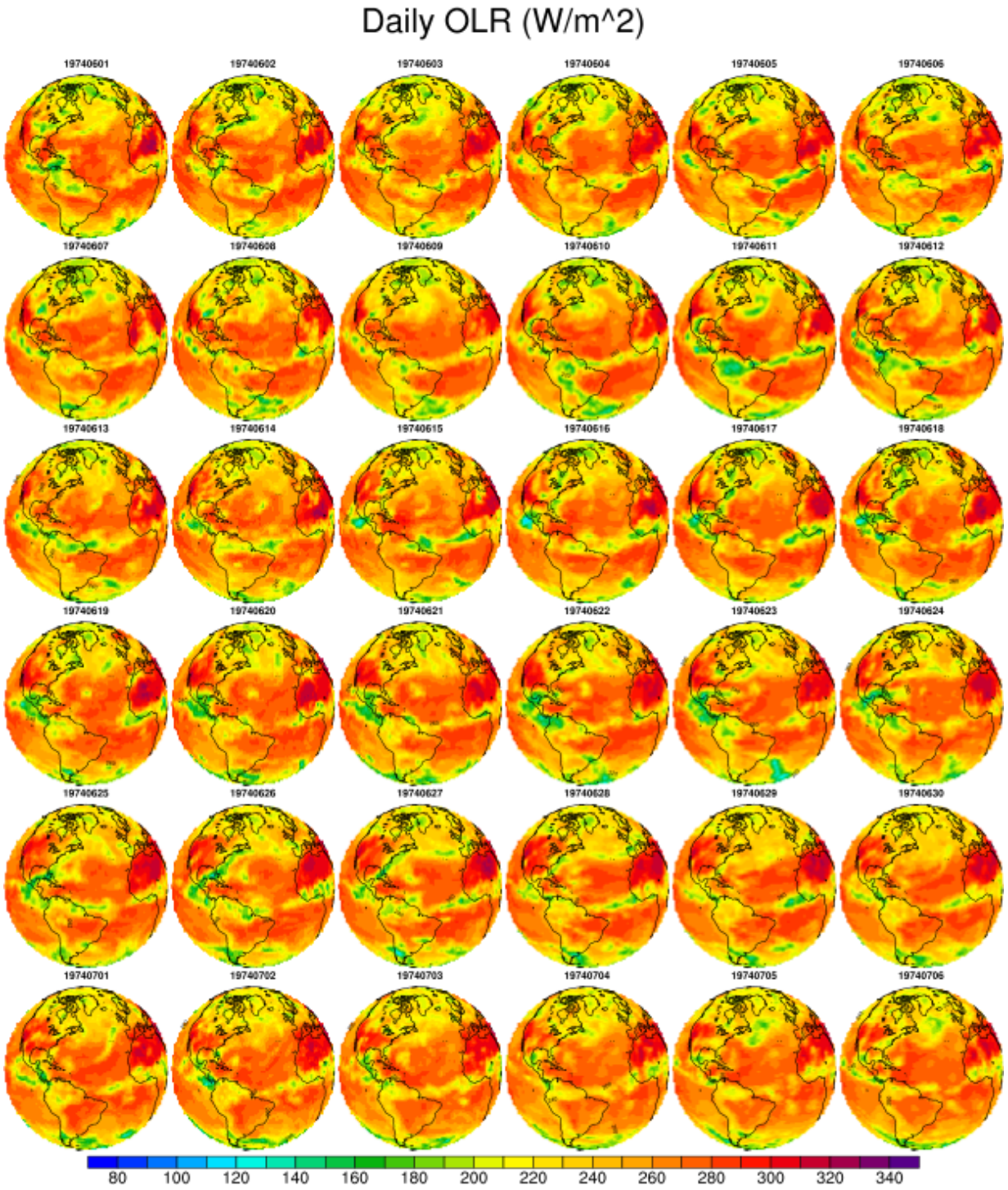
Zonal wind (m/2)



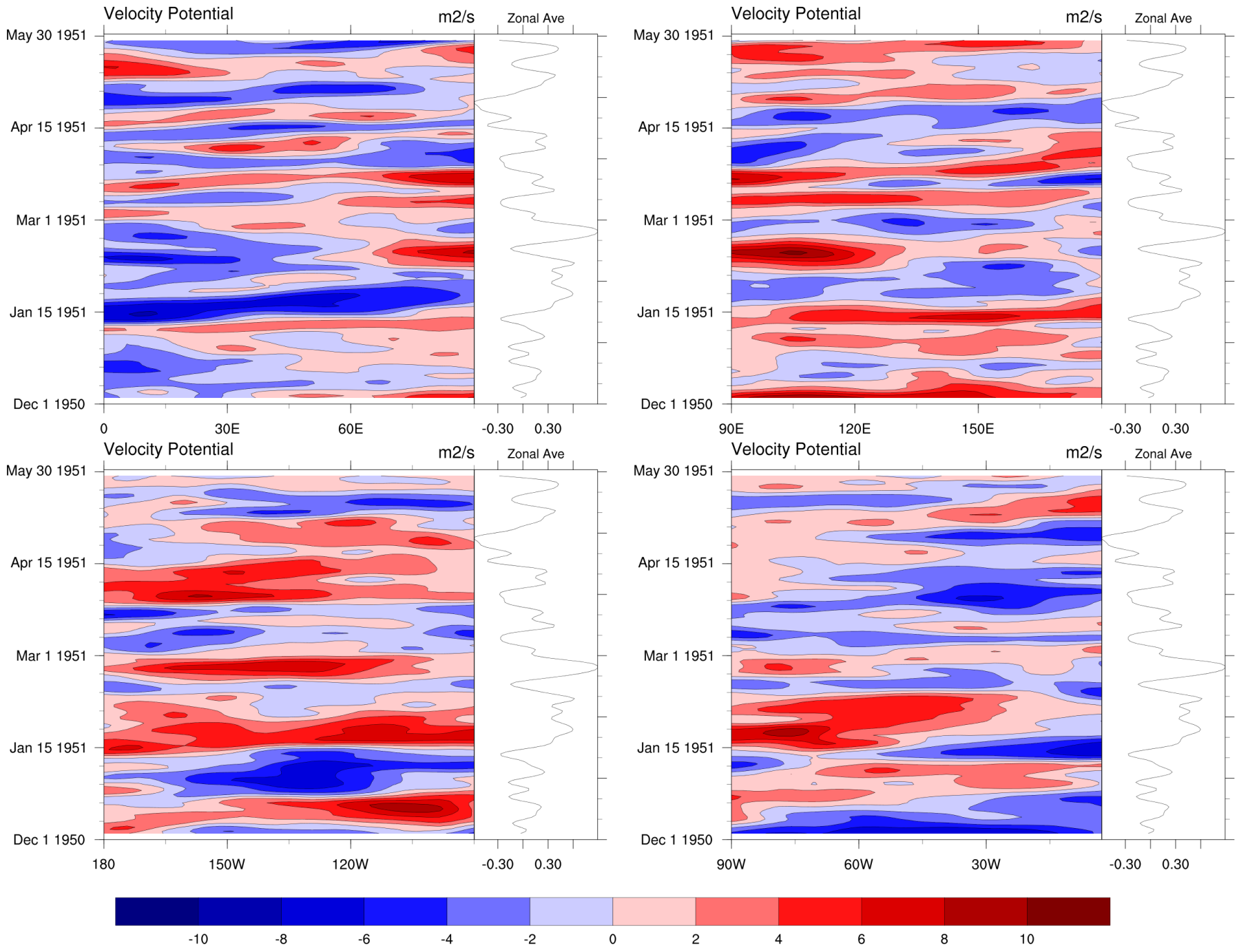
Zonal wind (m/2)



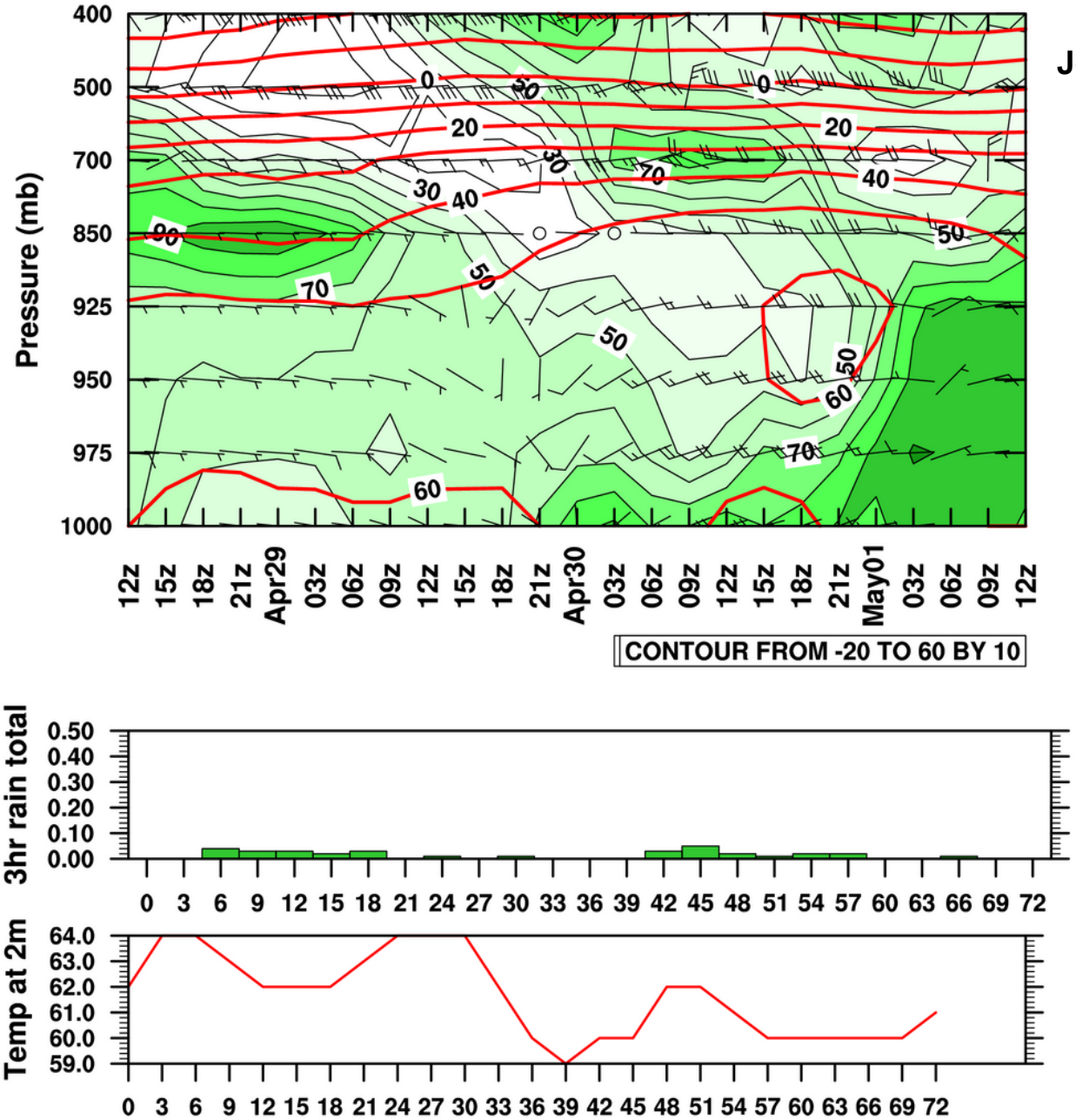
OLR file from Bob Setzenfand



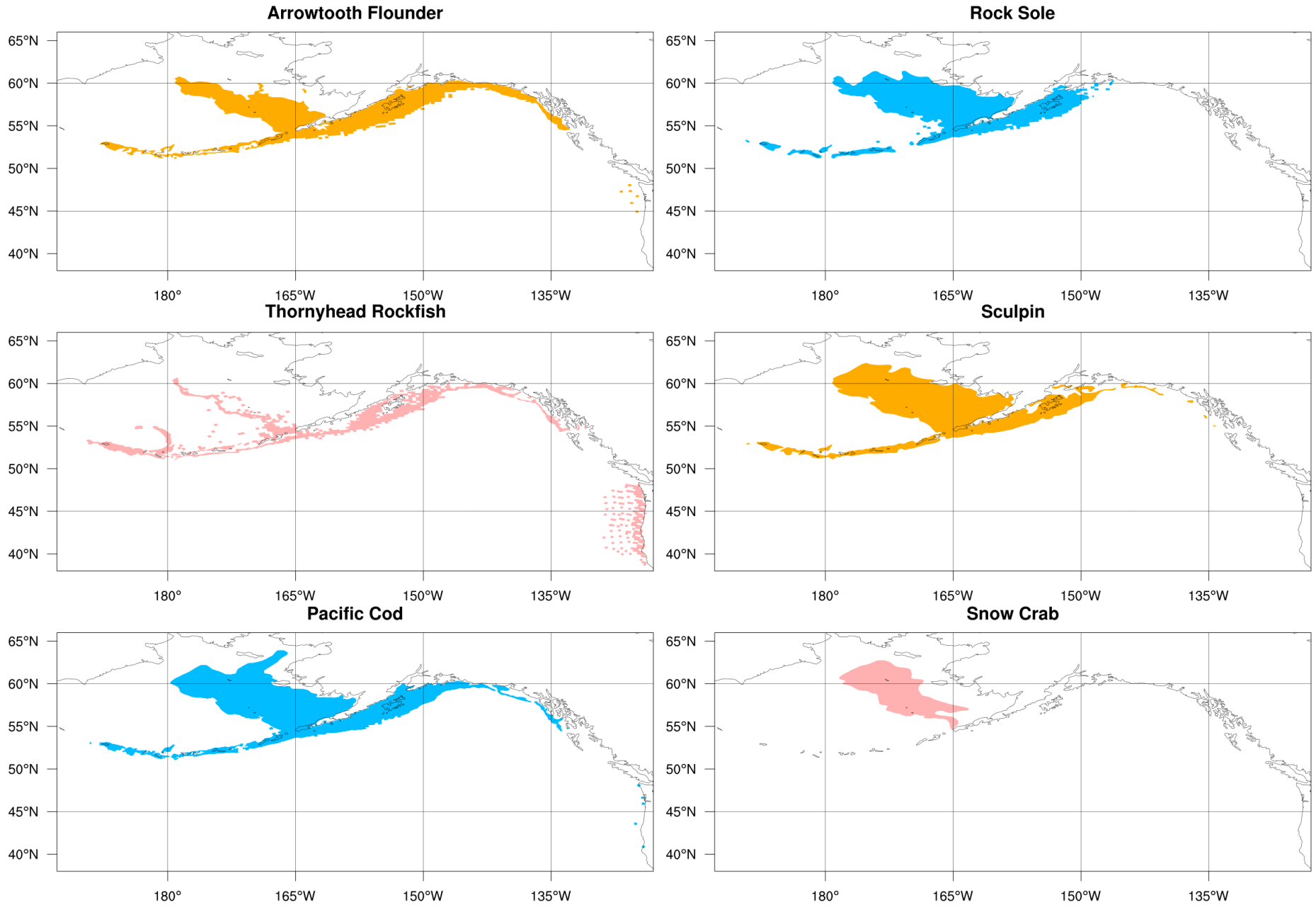
chi200_ud_smooth.nc



Meteogram for LGSA, 28/12Z

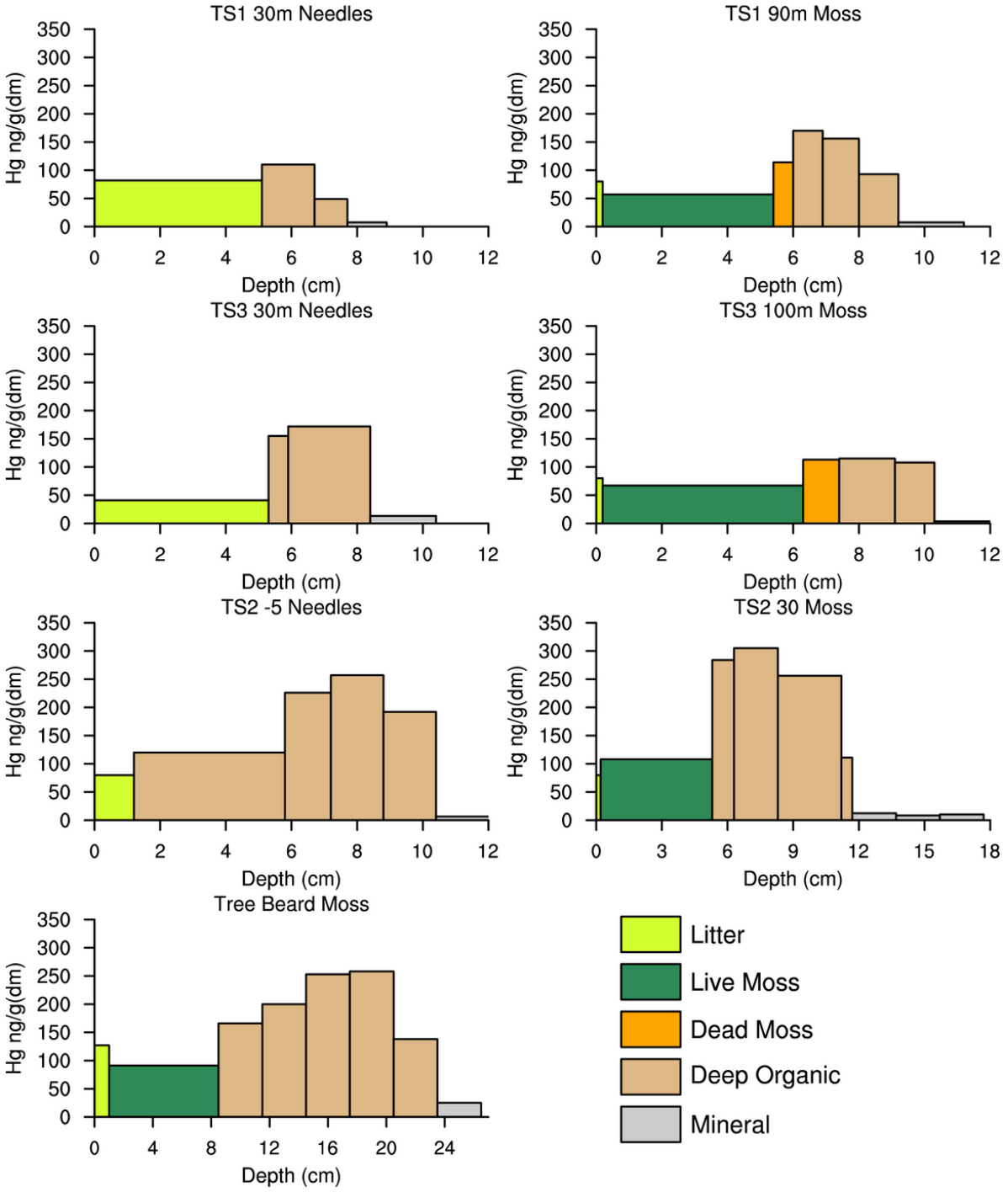


John Ertl, FNMOC

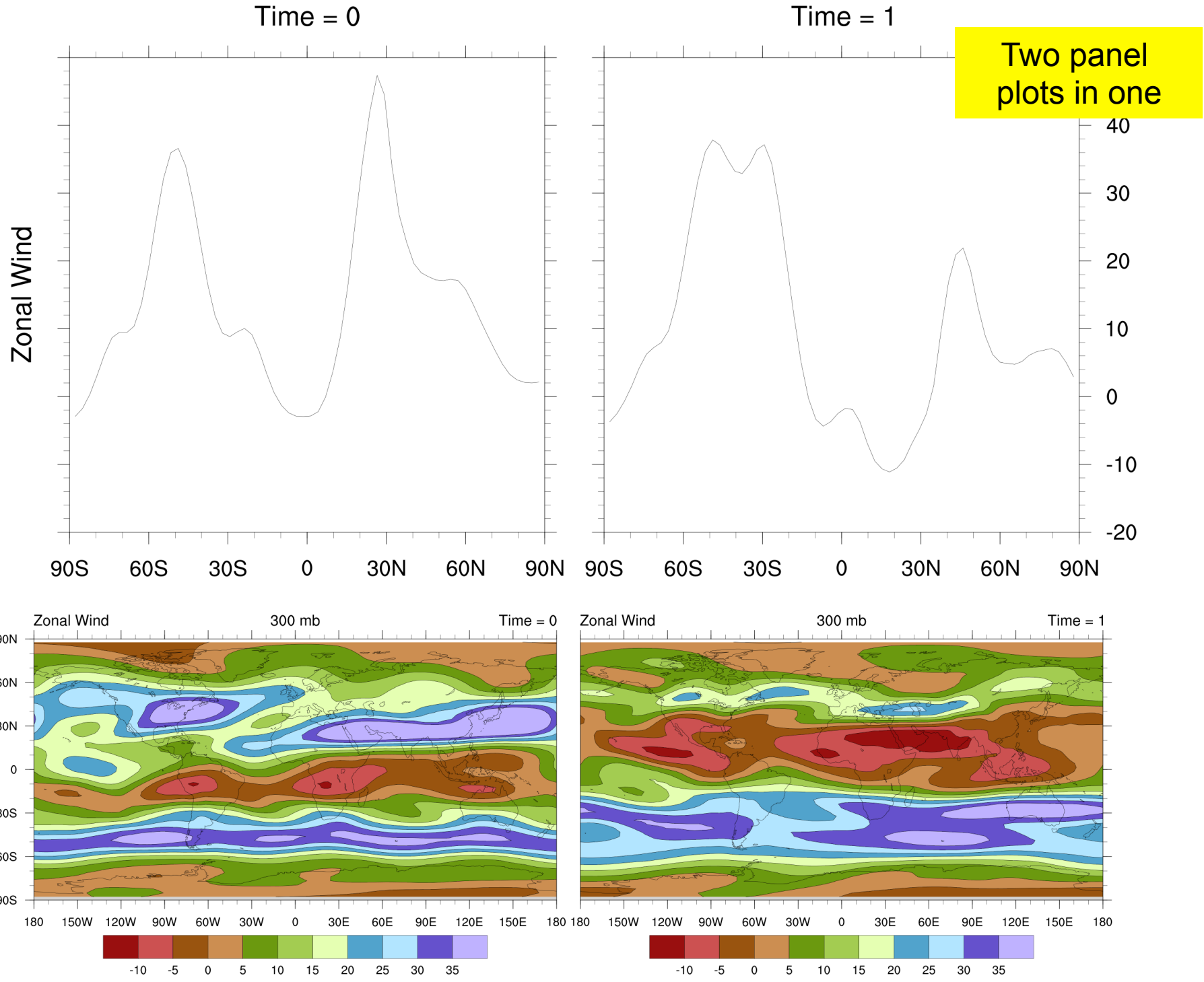


The "Alaska Essential Fish Habitat Species" shapefile was downloaded from:

http://alaskafisheries.noaa.gov/habitat/efh/efhshp/default.htm

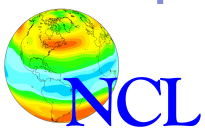


panels with a specially created labelbar


Time = 0
Time = 1
Two panel plots in one
Zonal Wind
40
30
20
10
0
-10
-20
90S
60S
30S
0
30N
60N
90N
Zonal Wind
300 mb
Time = 0
Zonal Wind
300 mb
Time = 1
90N
60N
30N
0
30S
60S
90S
180
150W
120W
90W
60W
30W
0
30E
60E
90E
120E
150E
180
-10
-5
0
5
10
15
20
25
30
35

Outline

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



Paneling plots with NCL – three methods

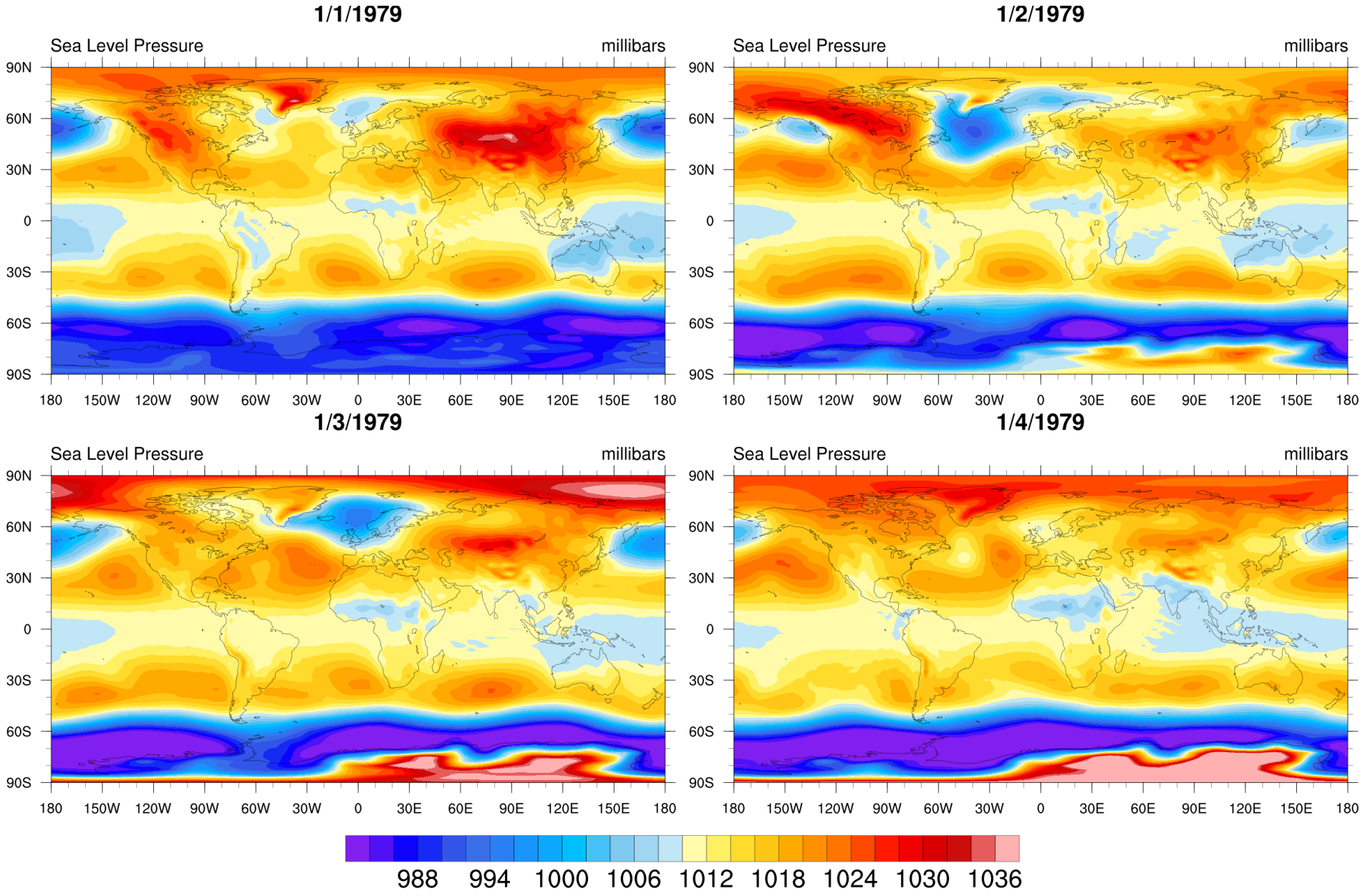
1. Using "gsn_panel" procedure

2. Setting vpXF / vpYF / vpWidthF / vpHeightF resources

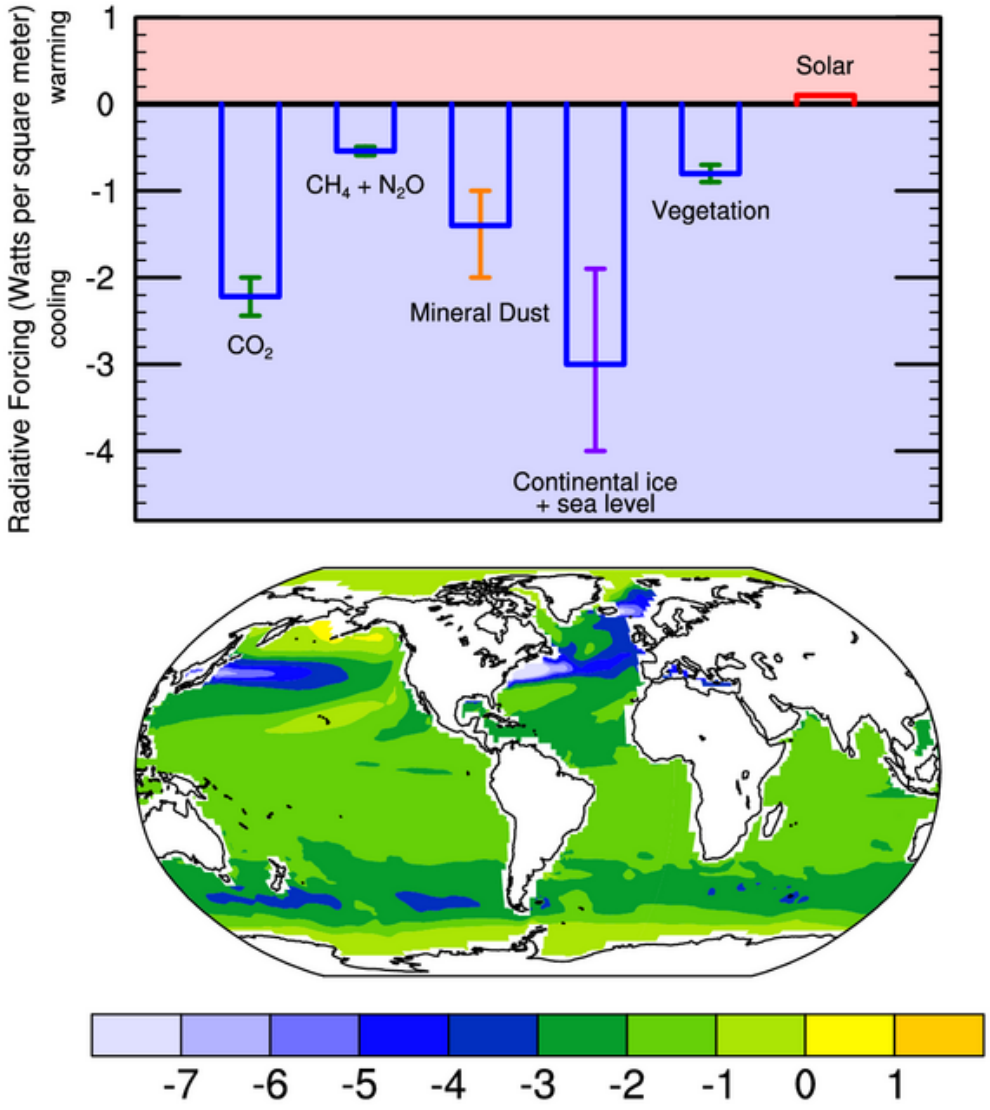
3. Using "gsn_attach_plots" function

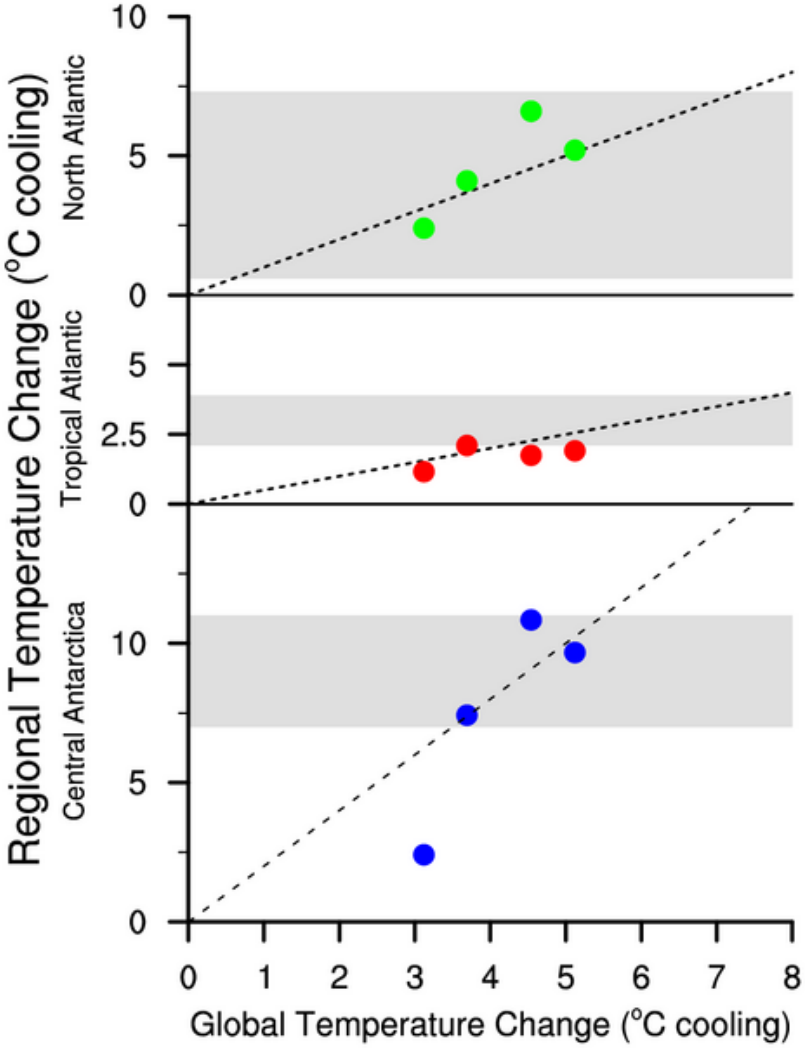
Note: gsn_panel uses method #2 "under the hood"

Plot created using “gsn_panel”



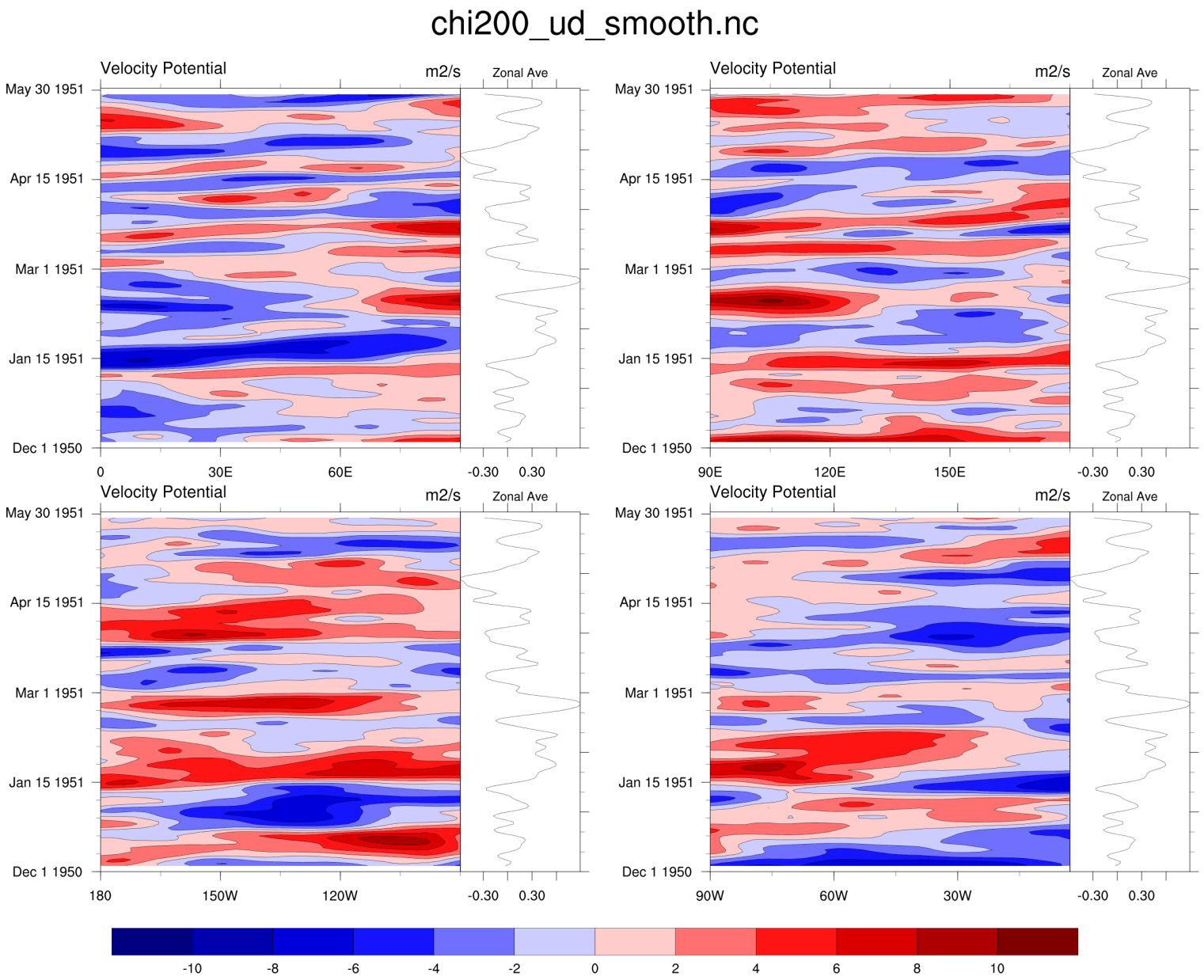
Plot created using vpXXXXF resources





Courtesy Adam Phillips, NCAR CGD

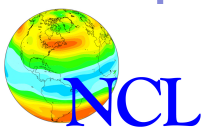
Plot created using “gsn_attach_plots” and “gsn_panel”



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

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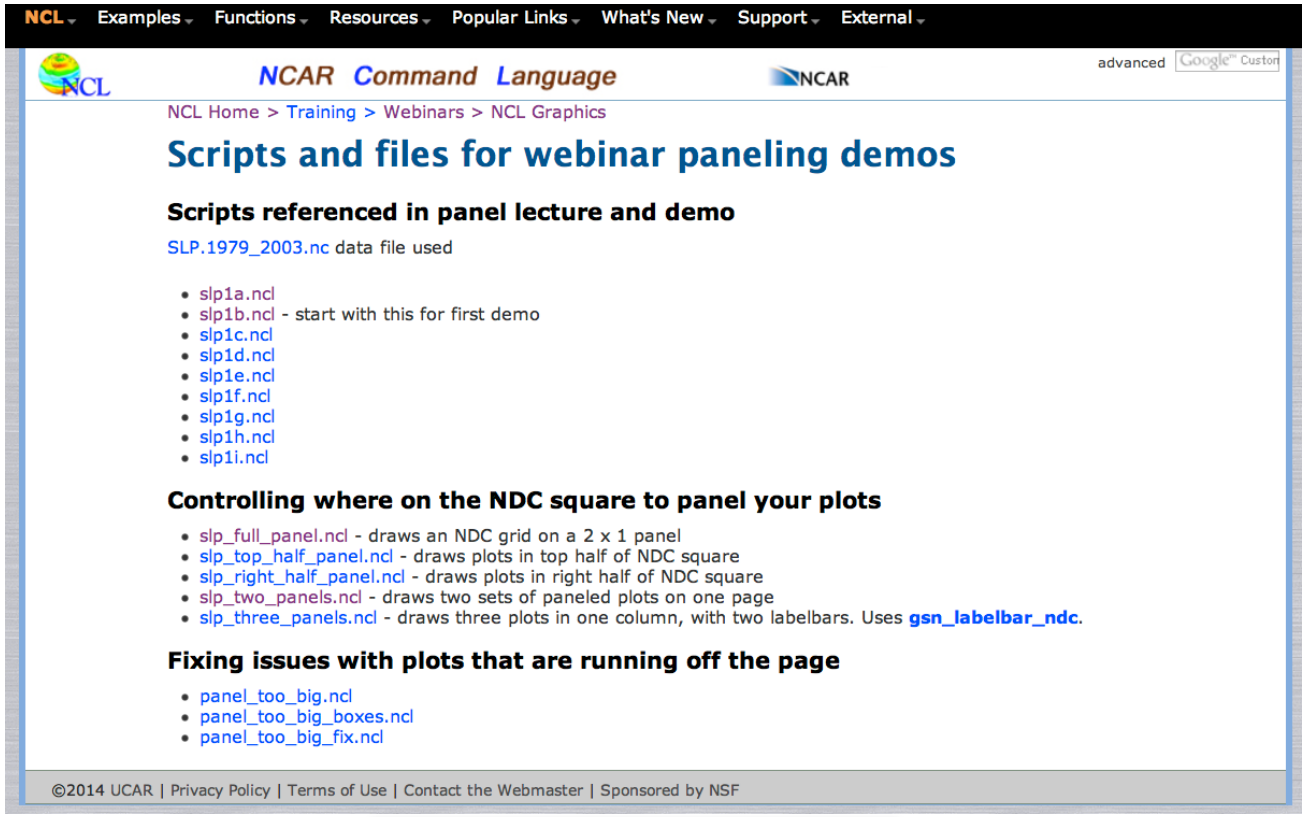
gsn_panel scripts

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

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

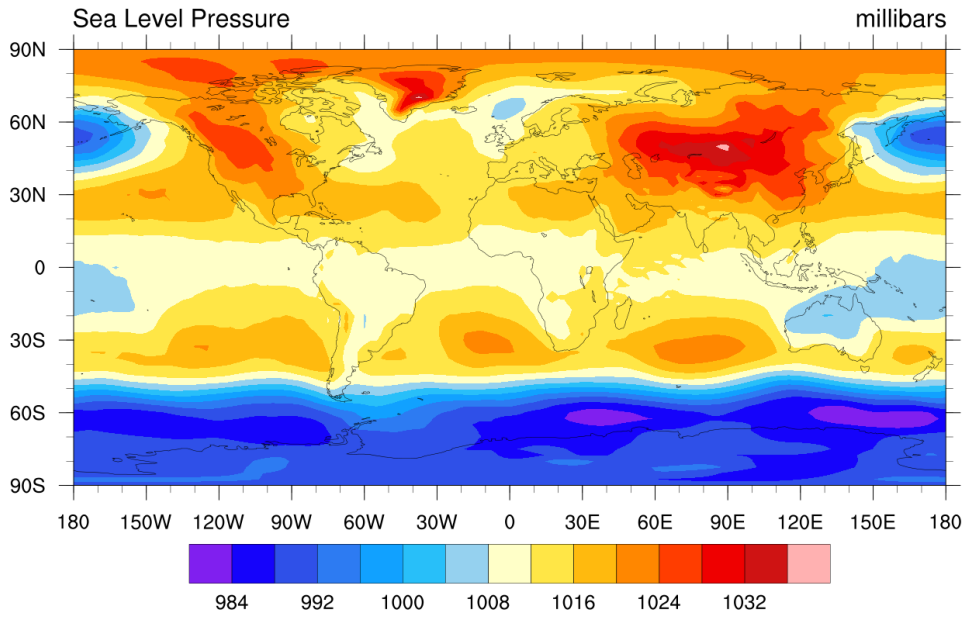
http://www.ncl.ucar.edu/Training/Webinars/NCL_Graphics/PanelDemo/

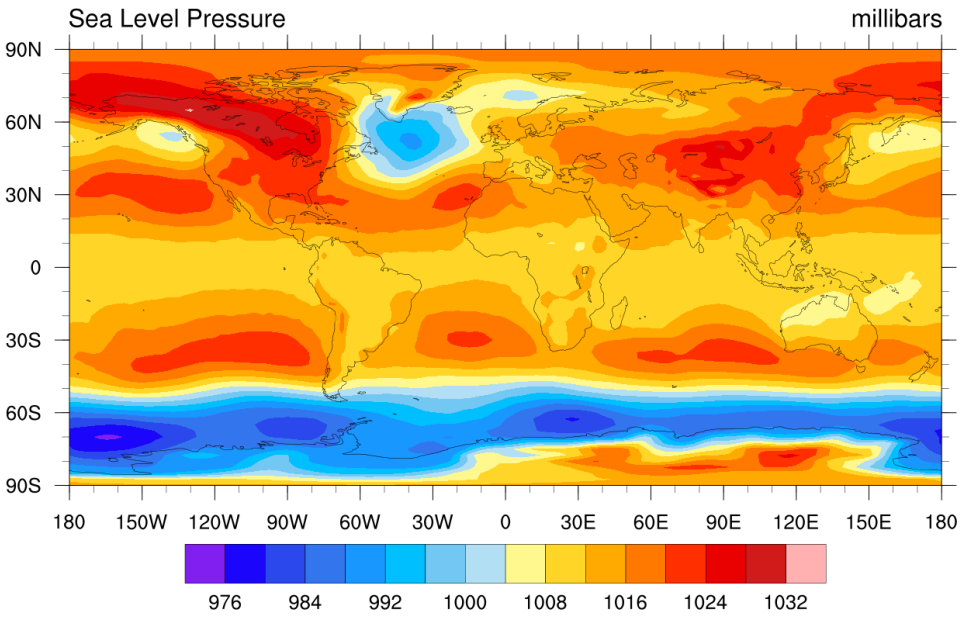


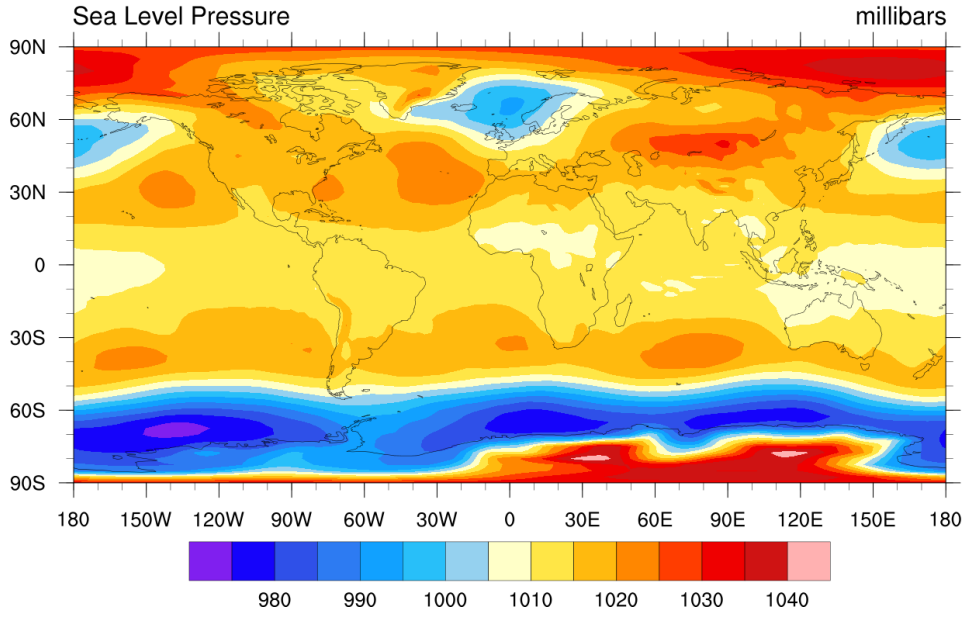
```
load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_code.ncl"
load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_csm.ncl"

;---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)
```

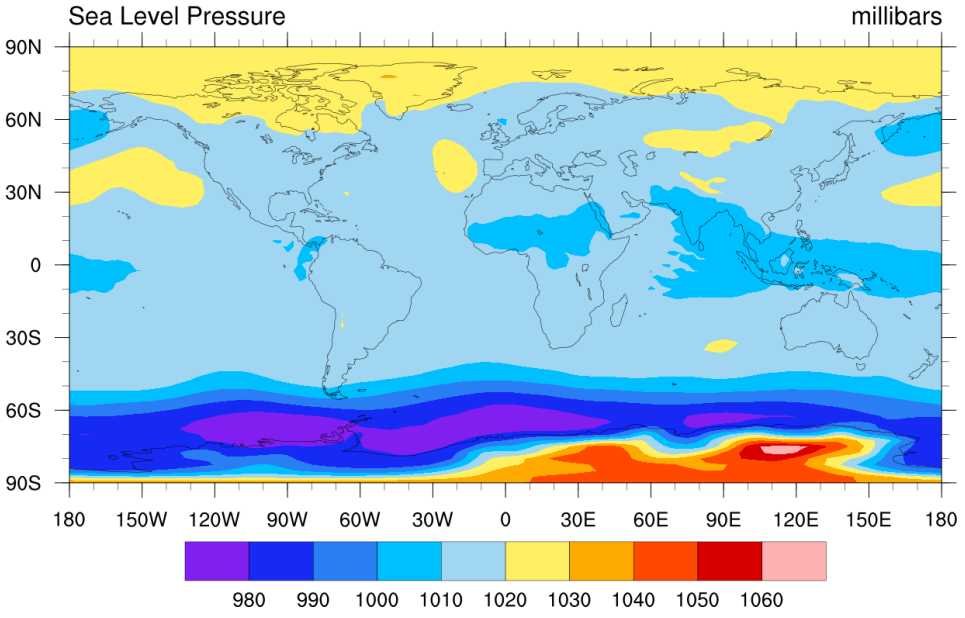
Same script, but with a “do loop”

```
;---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)
```


Sea Level Pressure
millibars
90N
60N
30N
0
30S
60S
90S
180 150W 120W 90W 60W 30W 0 30E 60E 90E 120E 150E 180
984 992 1000 1008 1016 1024 1032


Sea Level Pressure
millibars
90N
60N
30N
0
30S
60S
90S
180 150W 120W 90W 60W 30W 0 30E 60E 90E 120E 150E 180
976 984 992 1000 1008 1016 1024 1032


Sea Level Pressure
millibars
90N
60N
30N
0
30S
60S
90S
180 150W 120W 90W 60W 30W 0 30E 60E 90E 120E 150E 180
980 990 1000 1010 1020 1030 1040


Sea Level Pressure
millibars
90N
60N
30N
0
30S
60S
90S
180 150W 120W 90W 60W 30W 0 30E 60E 90E 120E 150E 180
980 990 1000 1010 1020 1030 1040 1050 1060

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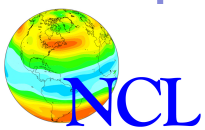

Demo

Start with “slp1b.ncl” script from previous example

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

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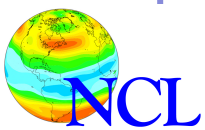
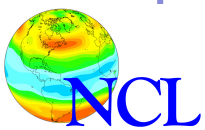
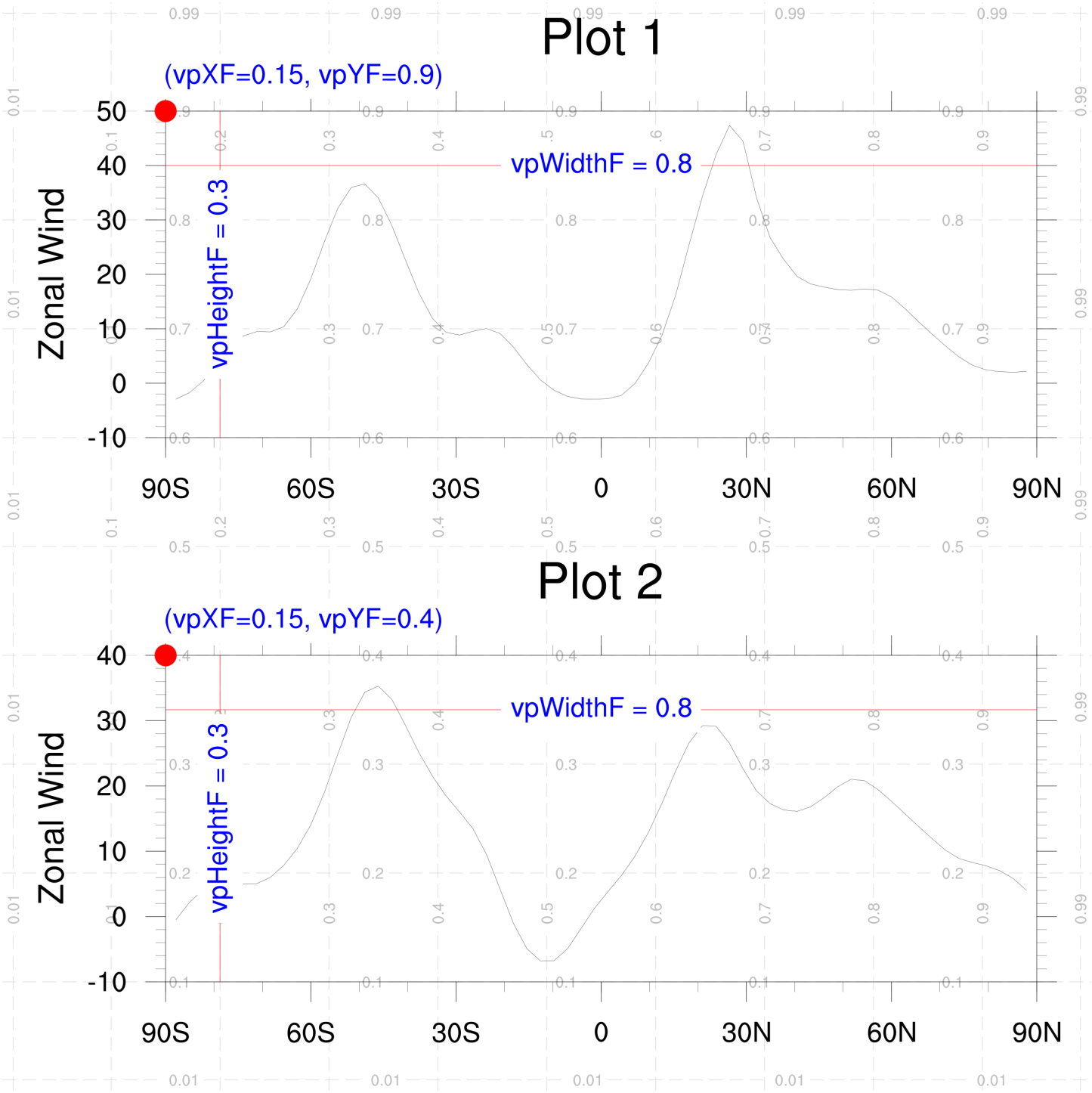


Method 2: setting "vp*XXXX*F" resources

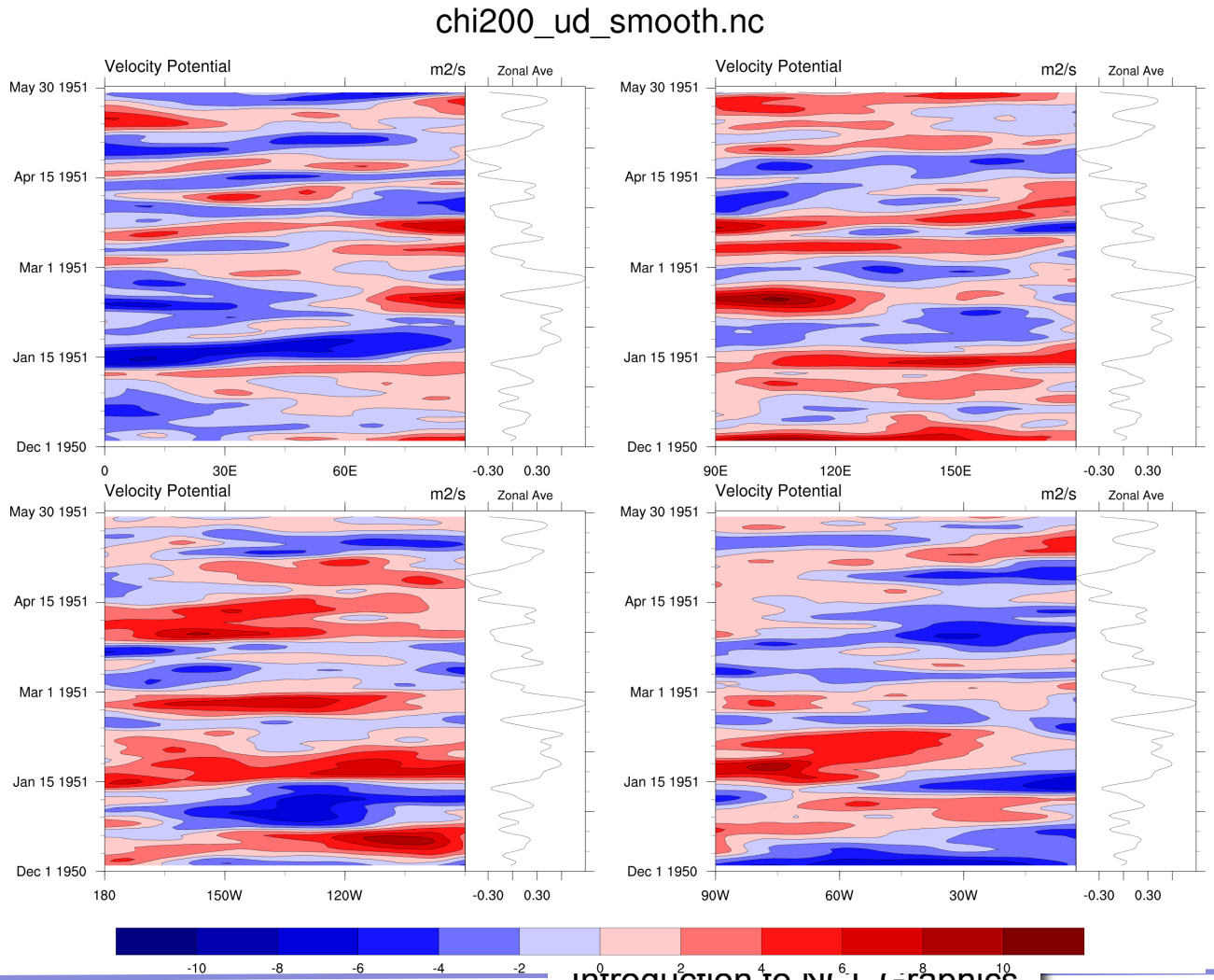
- Use if plots are different sizes
- Use if you need more control over location and/or size of plots
- vpXF / vpYF / vpWidthF / vpHeightF are the resources you need
- Use "drawNDCGrid" to draw a handy "viewport" grid




Plot 1
(vpXF=0.15, vpYF=0.9)
vpWidthF = 0.8
vpHeightF = 0.3
Zonal Wind
50
40
30
20
10
0
-10
90S
60S
30S
0
30N
60N
90N
Plot 2
(vpXF=0.15, vpYF=0.4)
vpWidthF = 0.8
vpHeightF = 0.3
Zonal Wind
40
30
20
10
0
-10
90S
60S
30S
0
30N
60N
90N

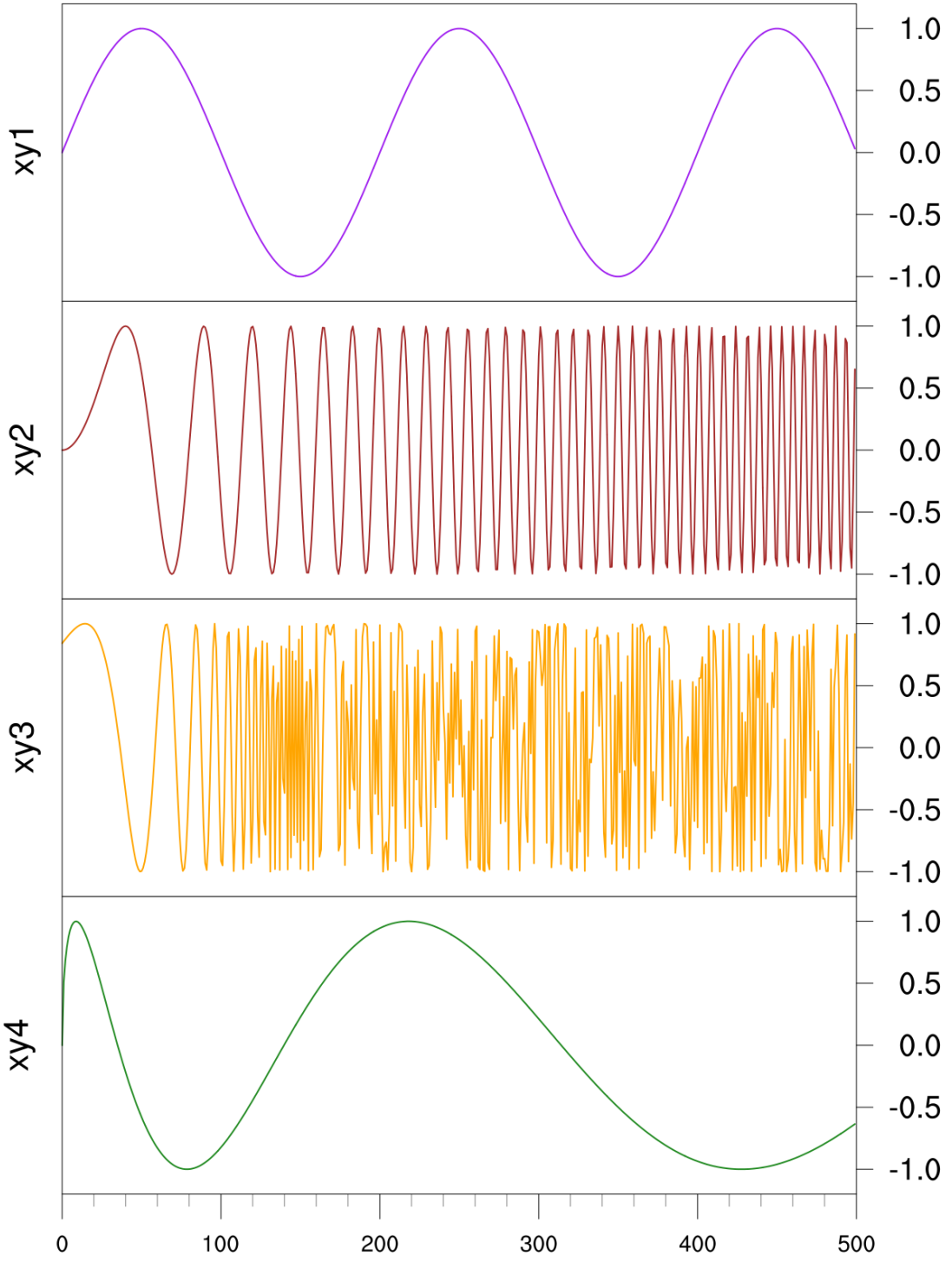
Method 3: using "gsn_attach_plots"

Use if plots need to share a common axis



"panel_10.ncl" on panel examples page

"xy_23.ncl" on panel examples page

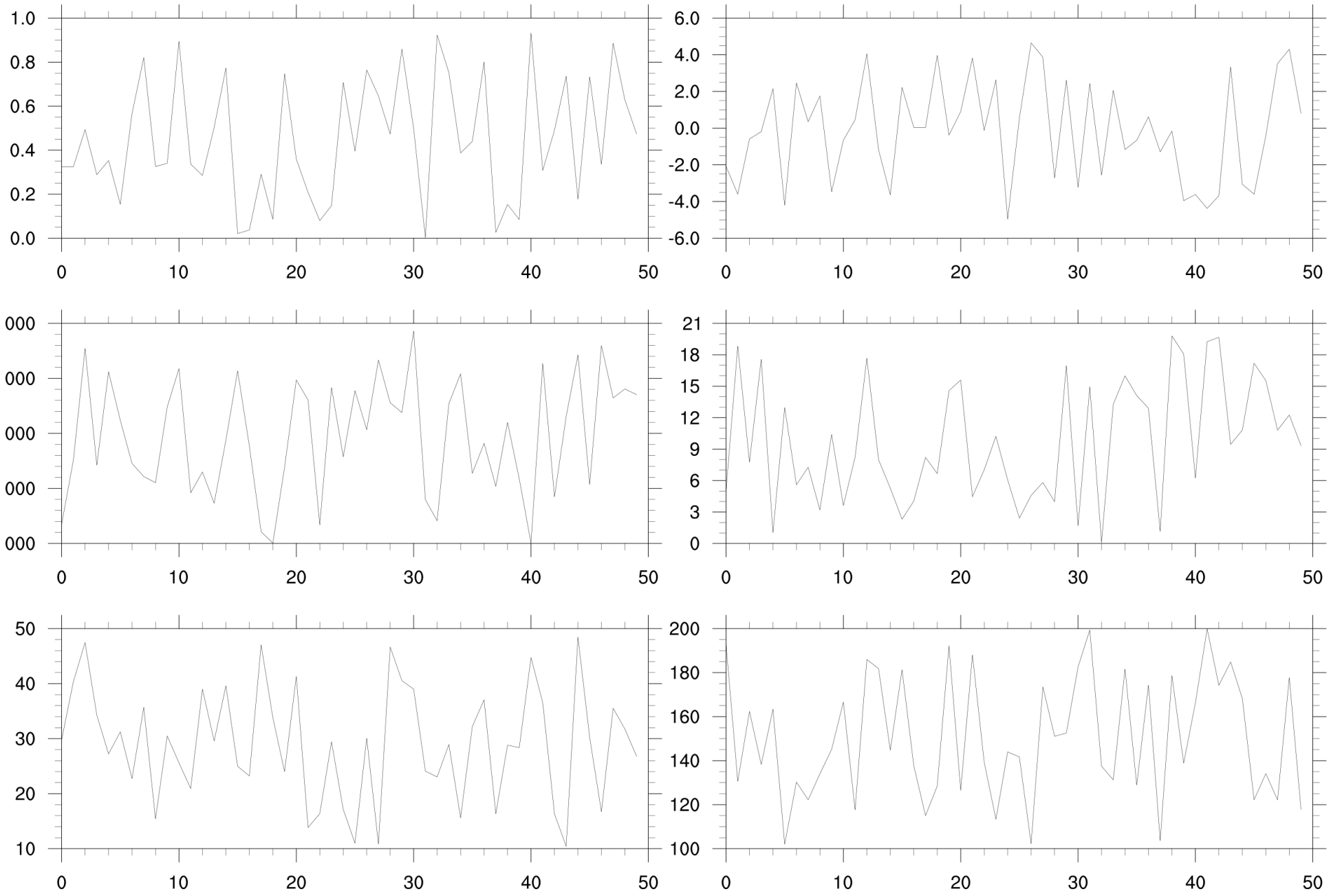


Tips for debugging panels gone bad

- Plots are not the same size, so paneling doesn't work
- Plots are going off the screen

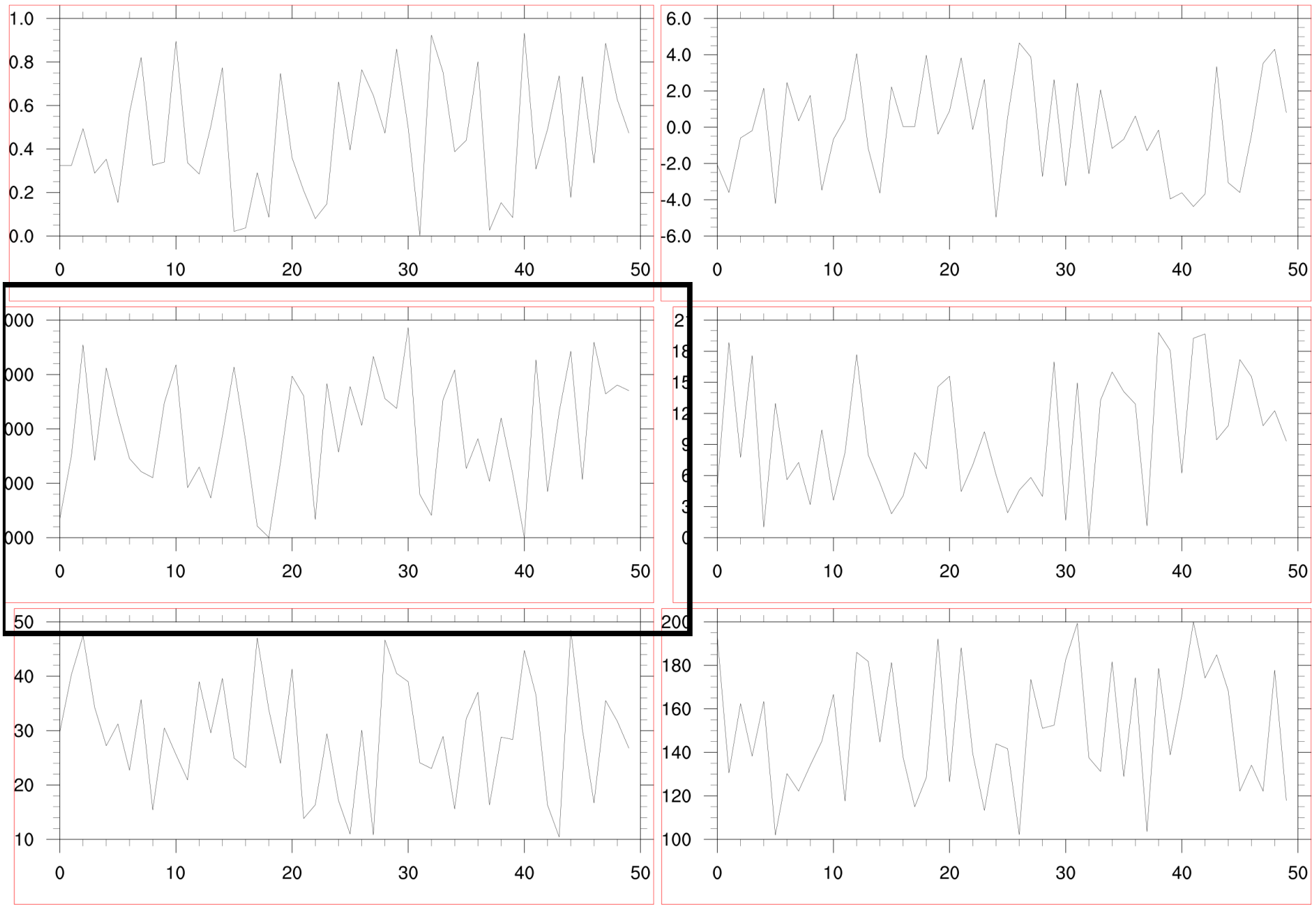
```
;---Generate arrays to hold dummy data
  npts   = 50
  nplots = 6
  y      = new((/nplots,npts/),float)
  ybeg   = (/0.00001,-5, 100000, 0, 10, 100/)  ; begin values
  yend   = (/1.00000, 5, 500000,20, 50, 200/)  ; end values

  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
  gsn_panel(wks,plot,(/3,2/),pres)
```

What's wrong with this set of plots?



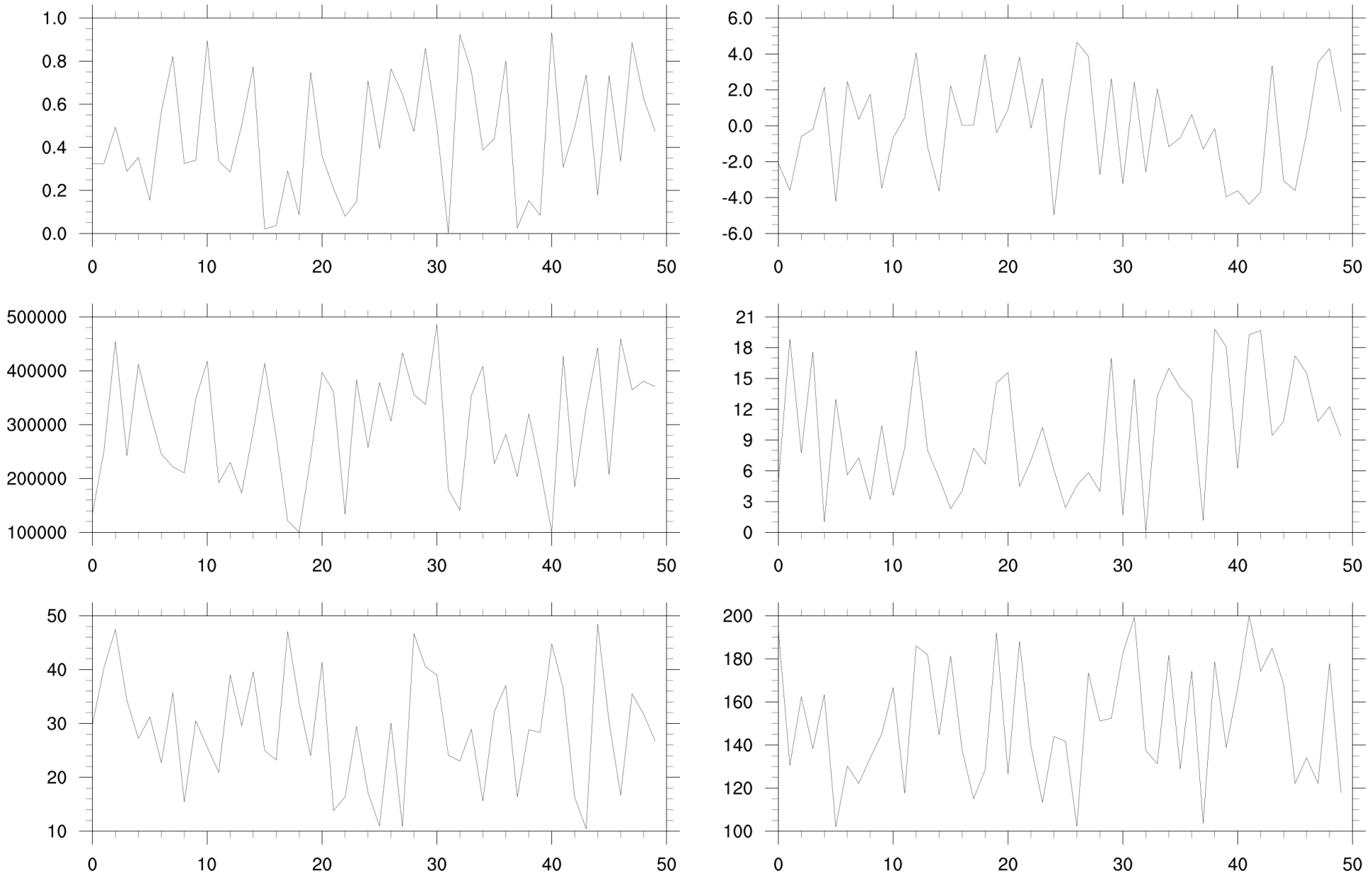
```
;---Generate arrays to hold dummy data
  npts   = 50
  nplots = 6
  y      = new((/nplots,npts/),float)
  ybeg   = (/0.00001,-5, 100000, 0, 10, 100/)  ; begin values
  yend   = (/1.00000, 5, 500000,20, 50, 200/)  ; end values

  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)
```

pres@gsnPanelBoxes = True



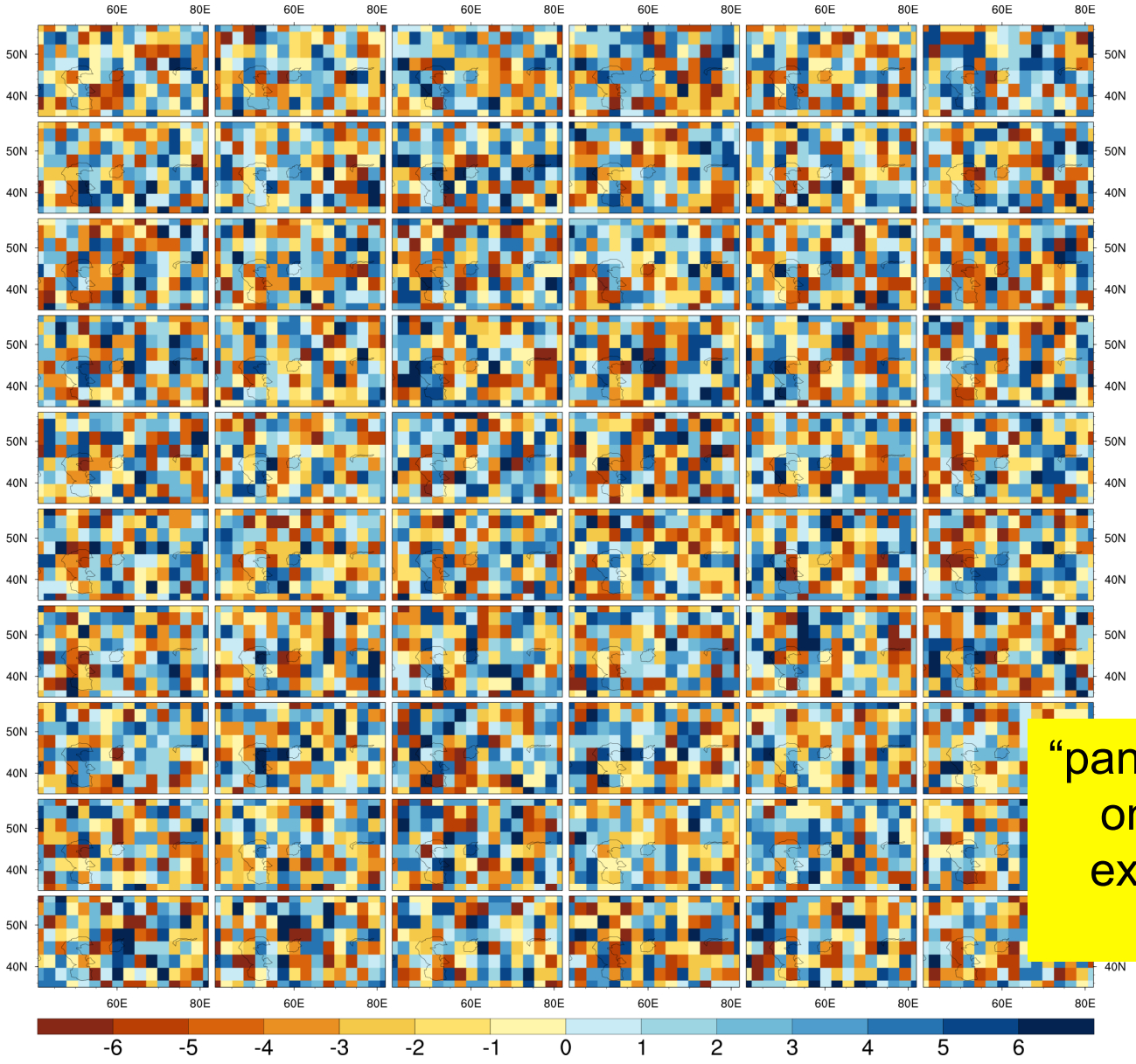
```
;---Generate arrays to hold dummy data
  npts   = 50
  nplots = 6
  y      = new((/nplots,npts/),float)
  ybeg   = (/0.00001,-5, 100000, 0, 10, 100/)  ; begin values
  yend   = (/1.00000, 5, 500000,20, 50, 200/)  ; end values

  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)
```

pres@gsnPanelScalePlotIndex = 2



gsnPanelScalePlotIndex

Useful when plots have different tickmarks



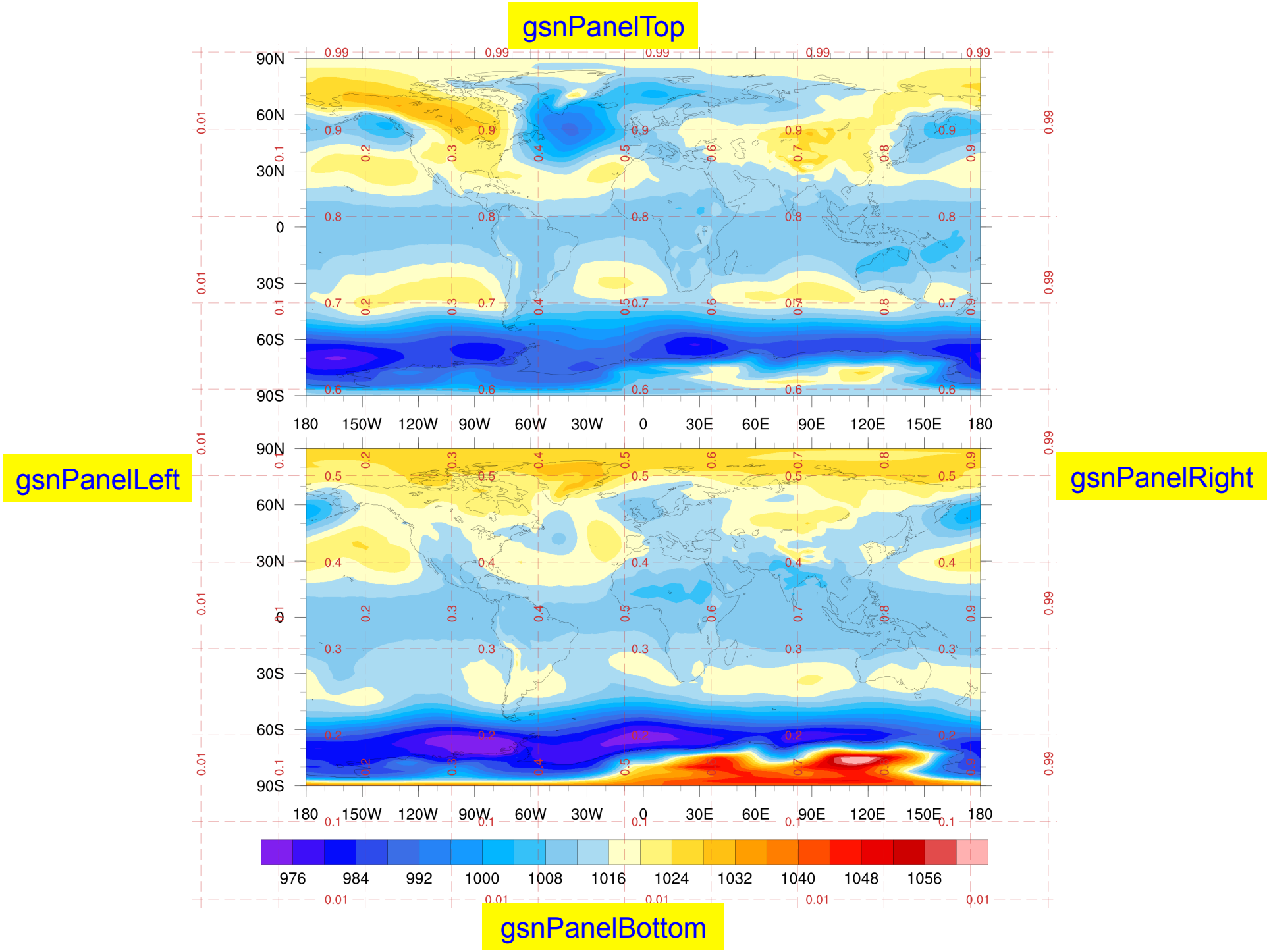
"panel_23.ncl" on panel examples page

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

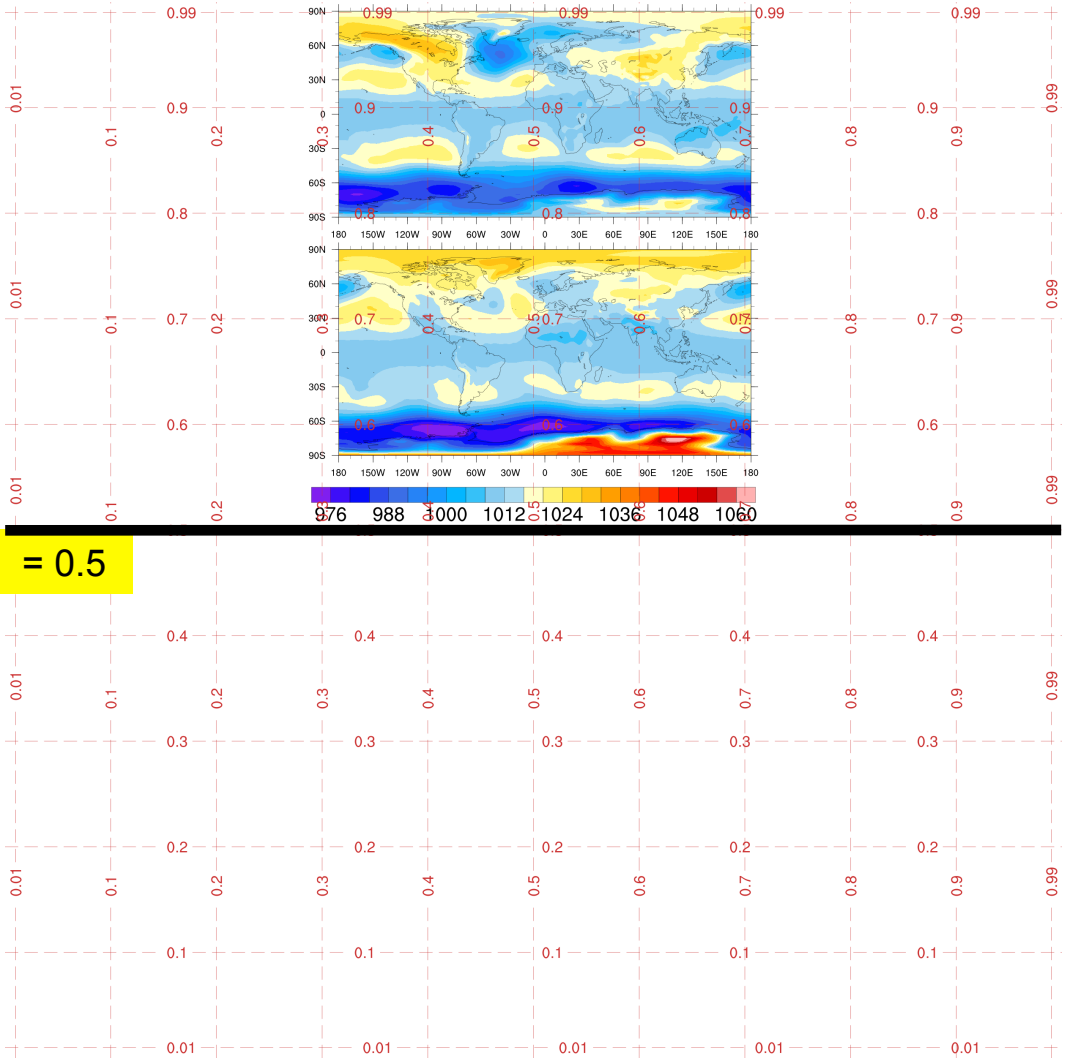
- Panels are drawn in a unit square
- By default:
  - `gsnPanelTop = 1.0`
  - `gsnPanelBottom = 0.0`
  - `gsnPanelLeft = 0.0`
  - `gsnPanelRight = 1.0`
- Can use these resources to restrict area for panels


gsnPanelTop
gsnPanelLeft
gsnPanelRight
gsnPanelBottom
90N
60N
30N
0
30S
60S
90S
180
150W
120W
90W
60W
30W
0
30E
60E
90E
120E
150E
180
976
984
992
1000
1008
1016
1024
1032
1040
1048
1056

Tip: NDC grid was drawn with drawNDCGrid

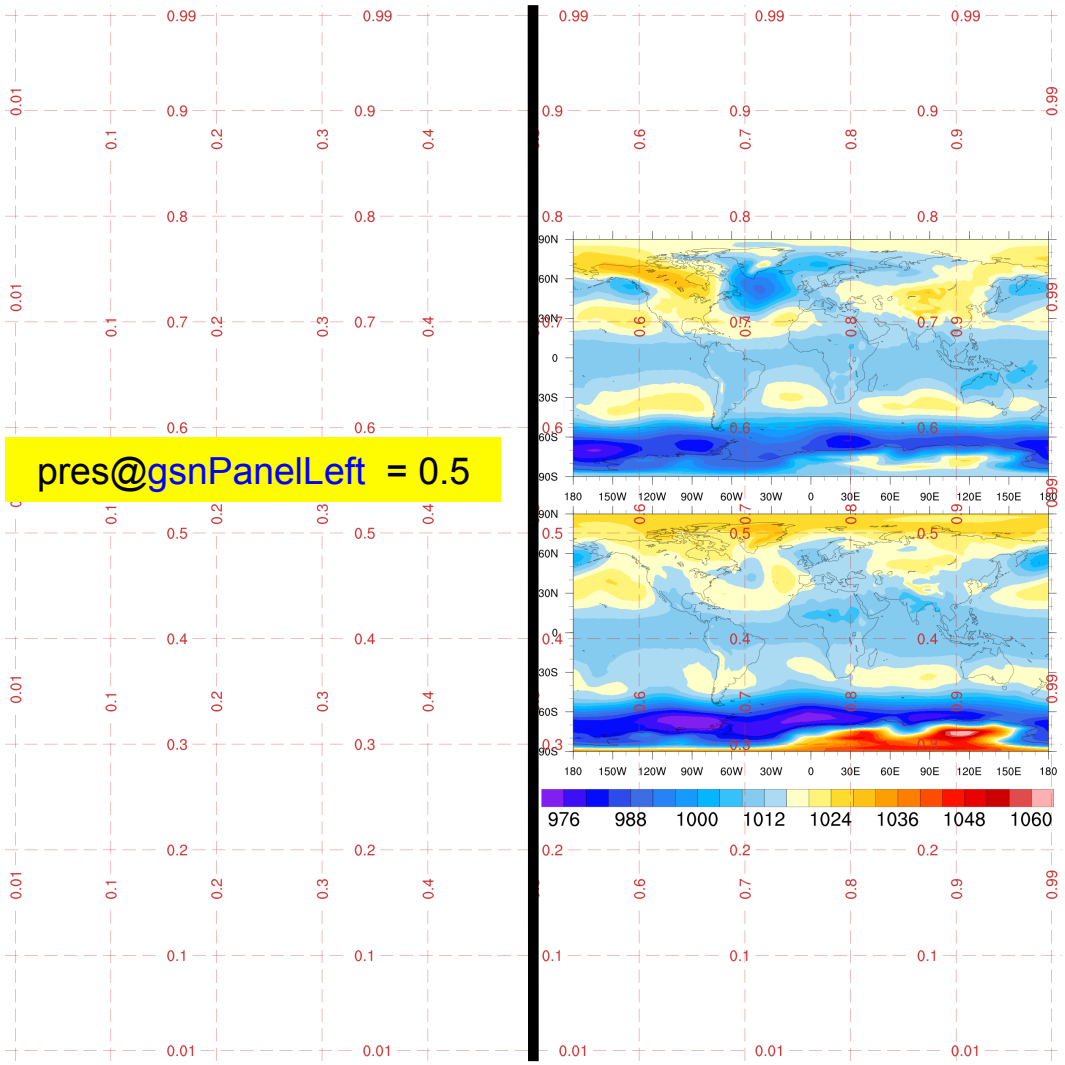
```
pres                    = True
pres@gsnFrame           = False   ; Don't advance frame
pres@gsnPanelLabelBar   = True
gsn_panel(wks,plot,(/2,1/),pres)
drawNDCGrid(wks)                  ; Draws an NDC grid
frame(wks)                        ; Now advance frame
```

```
pres                    = True
pres@gsnFrame           = False
pres@gsnPanelLabelBar   = True
pres@gsnPanelBottom     = 0.5
gsn_panel(wks,plot,(/2,1/),pres)
```

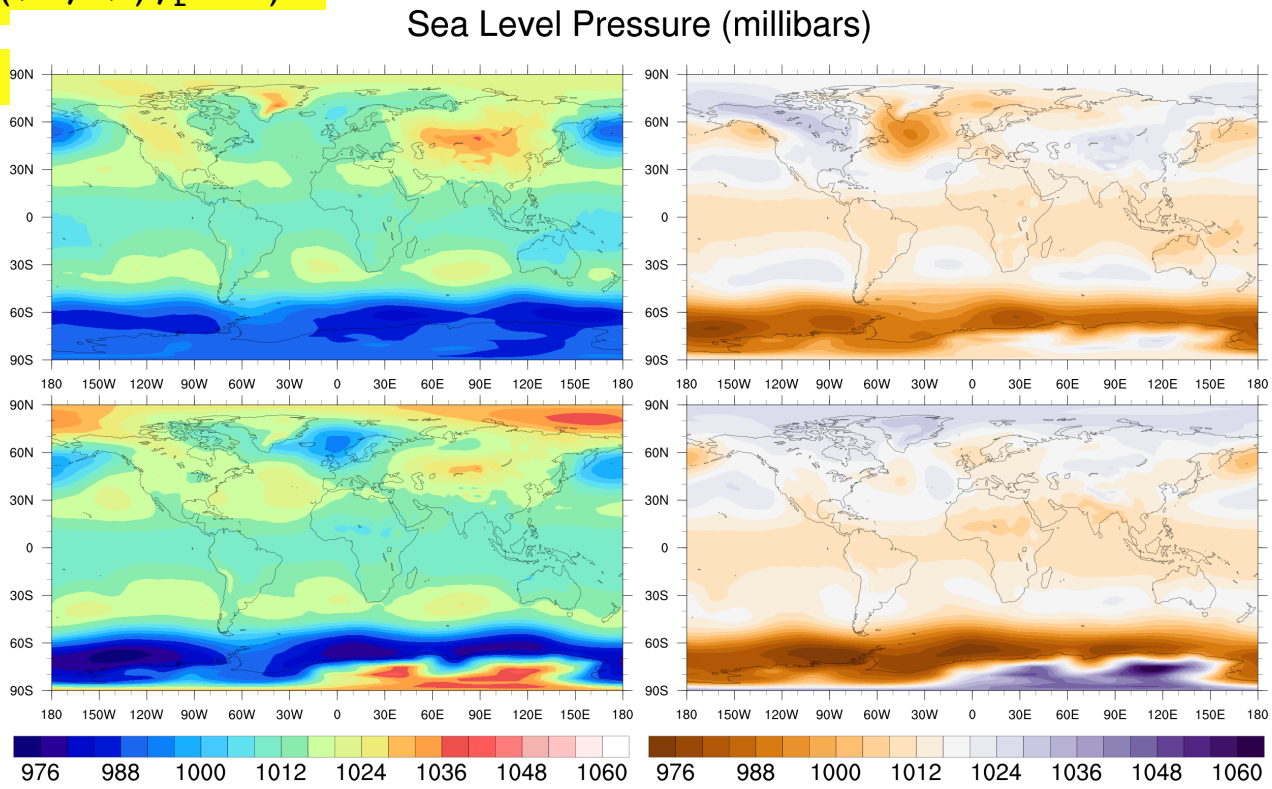


pres@gsnPanelBottom = 0.5

```
pres                    = True
pres@gsnFrame           = False
pres@gsnPanelLabelBar   = True
pres@gsnPanelLeft       = 0.5
gsn_panel(wks,plot,(/2,1/),pres)
```

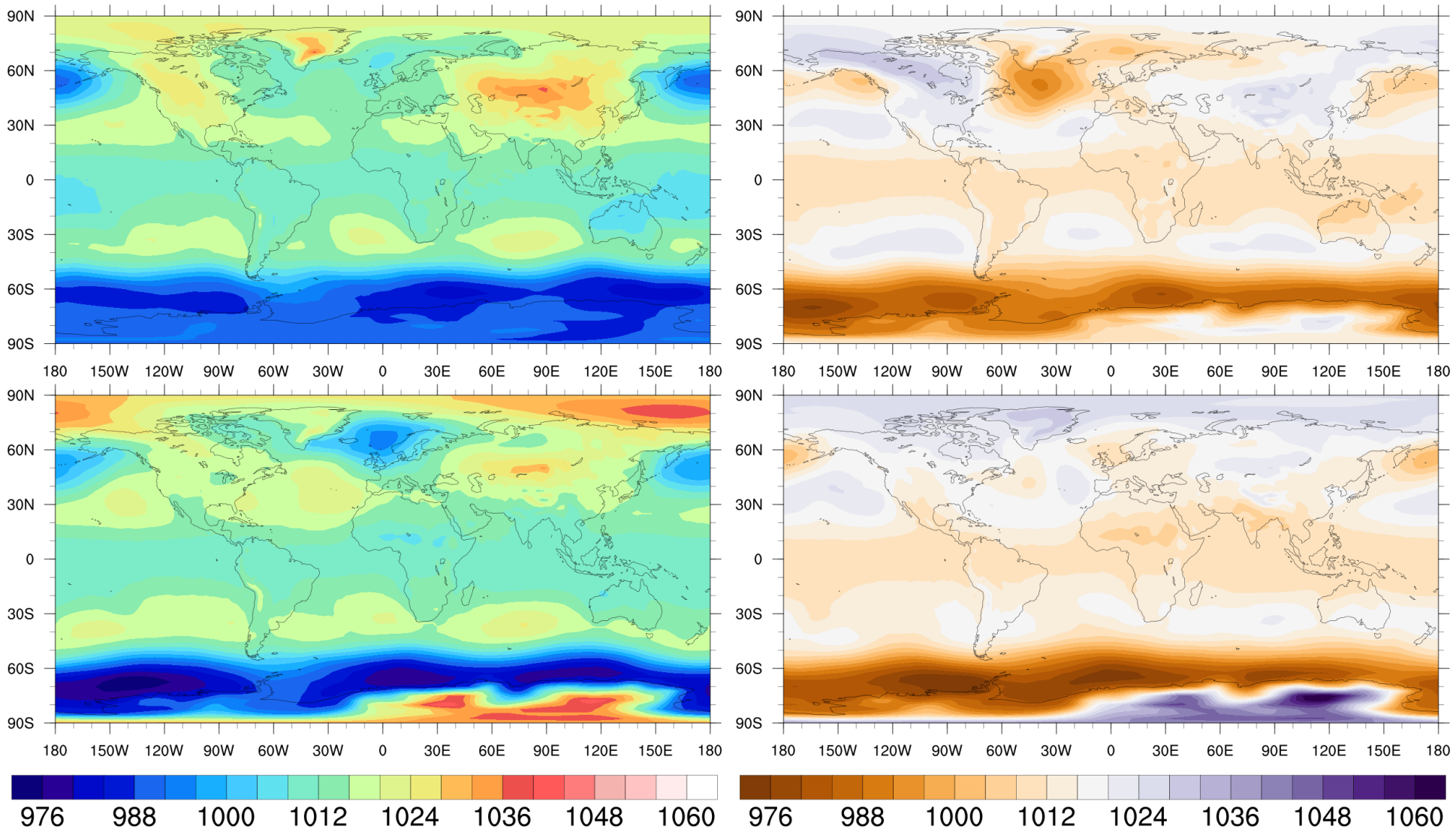


```
;---Create two columns of panel plots
  pres                    = True
  pres@gsnFrame           = False
  pres@gsnPanelLabelBar = True

;---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)
```



slp_two_panels.ncl

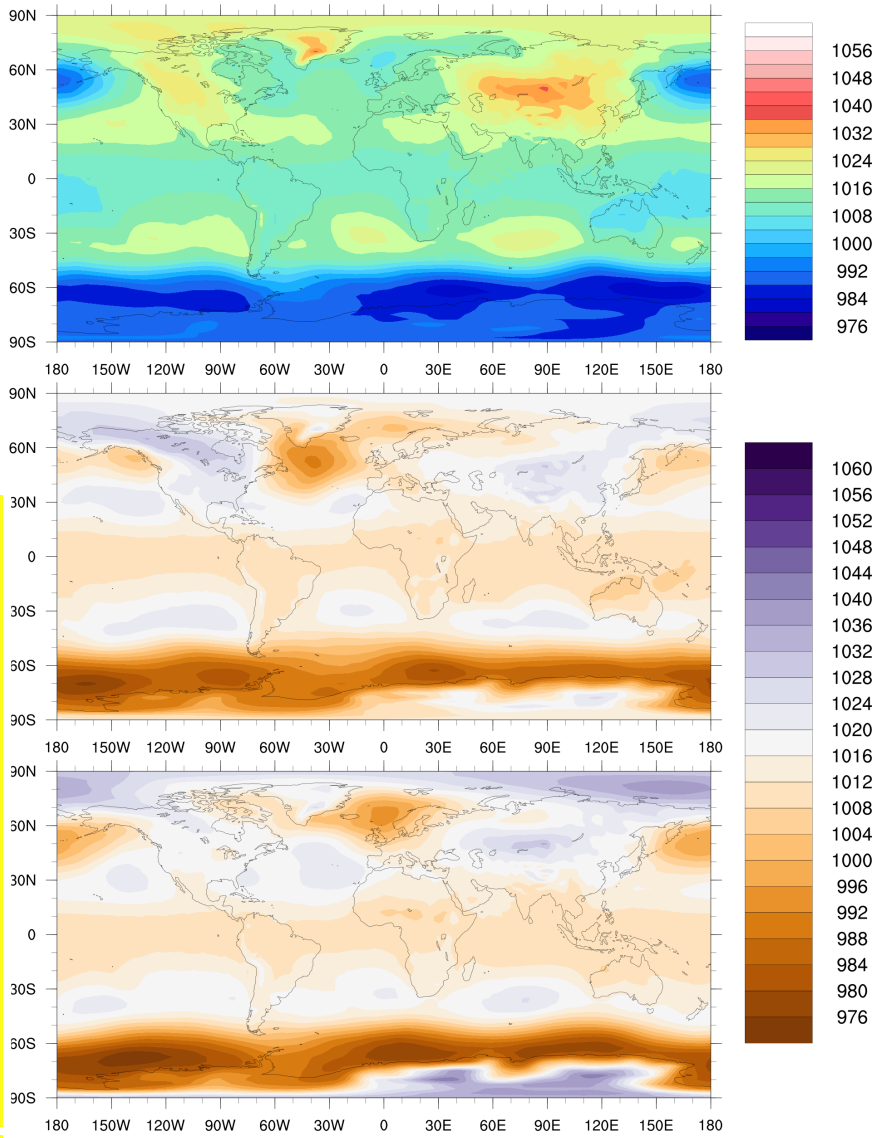
Sea Level Pressure (millibars)



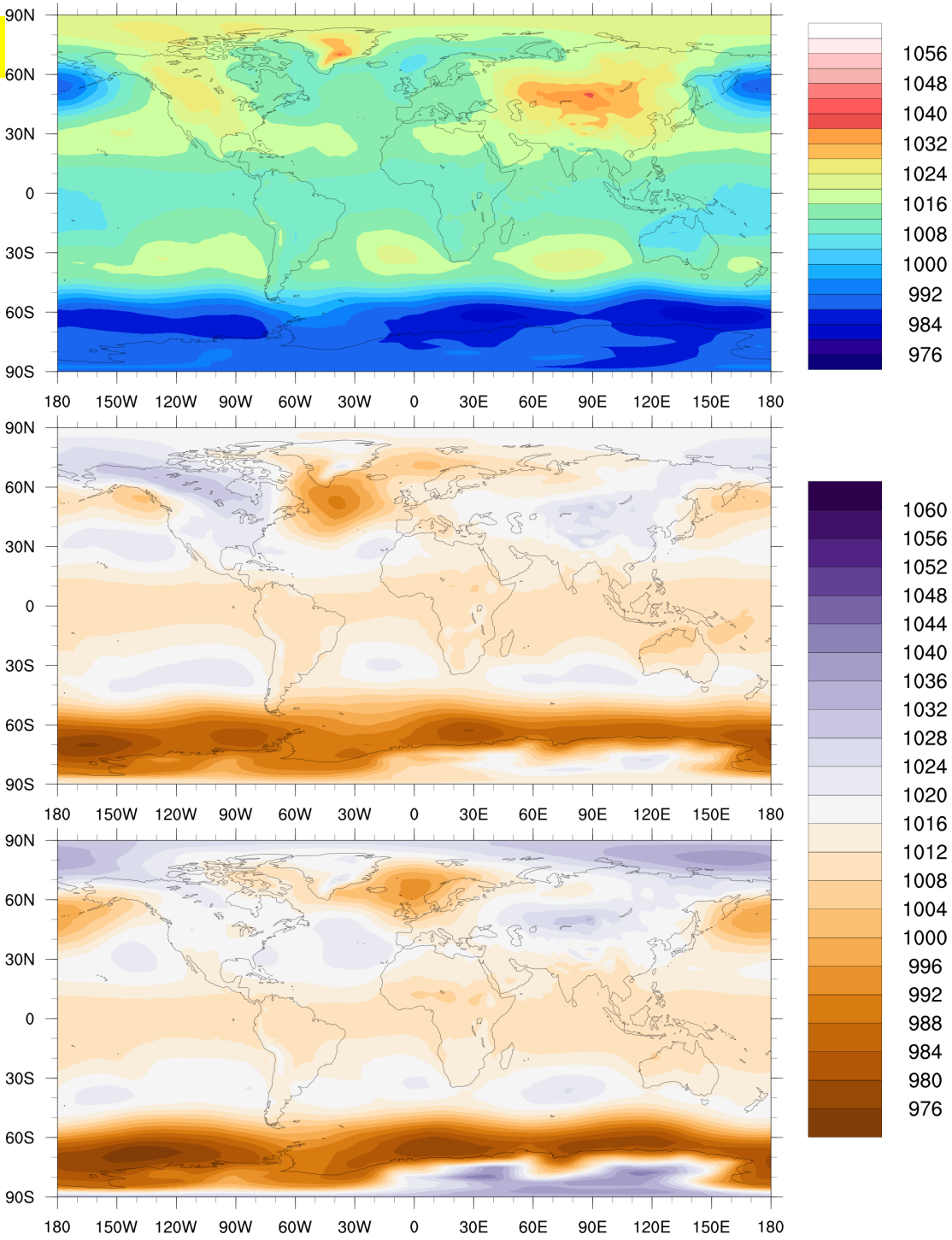
```
;---Create one column of plots
pres                    = True
pres@gsnFrame           = False

;---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)
```

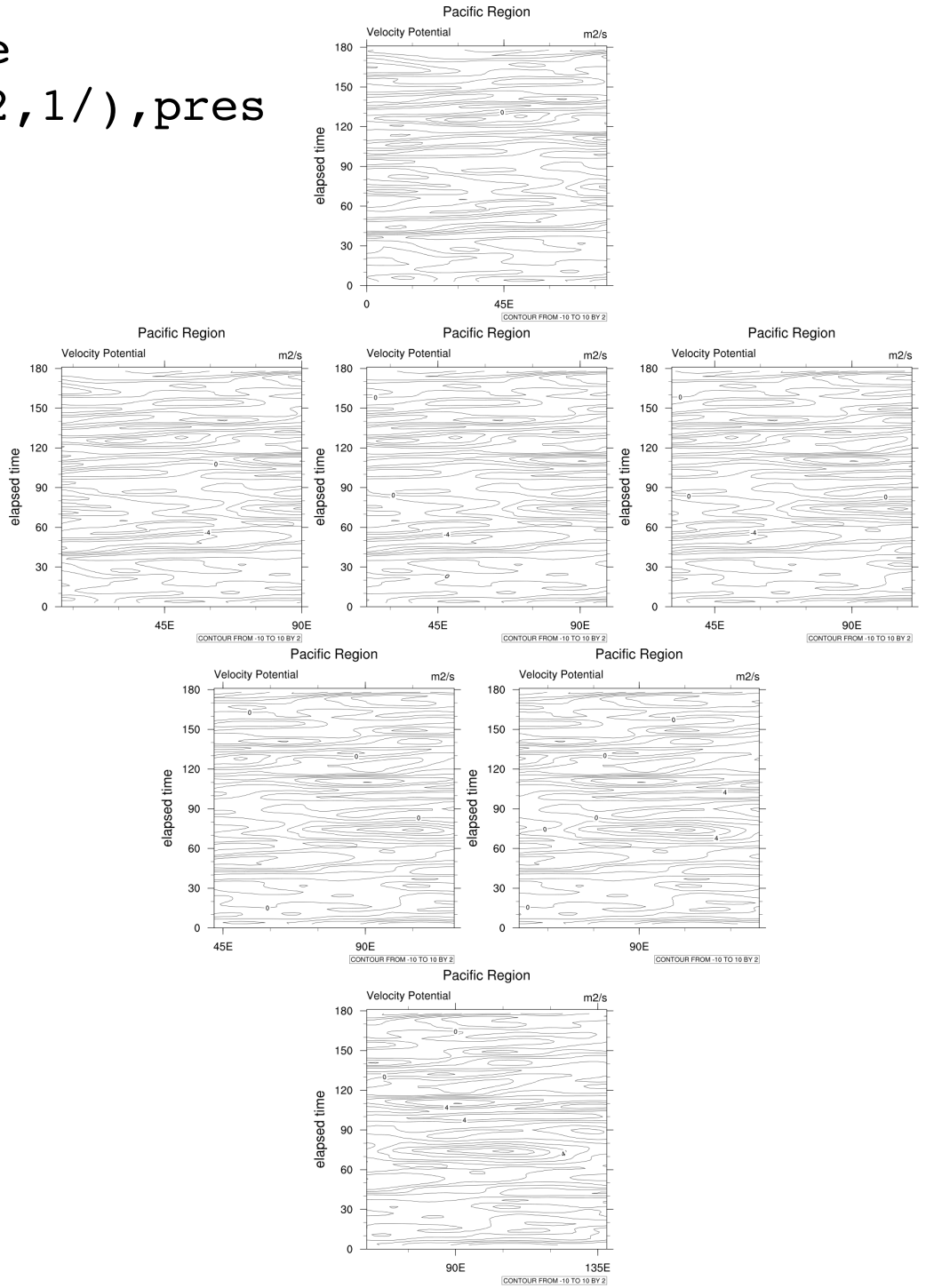
```
;---Change location, size, colors of second labelbar
lbres@vpHeightF             = 0.55
lbres@lbFillColors          = colors2
gsn_labelbar_ndc (wks,ncolors,labels,0.79,0.62,lbres)

frame(wks)
```

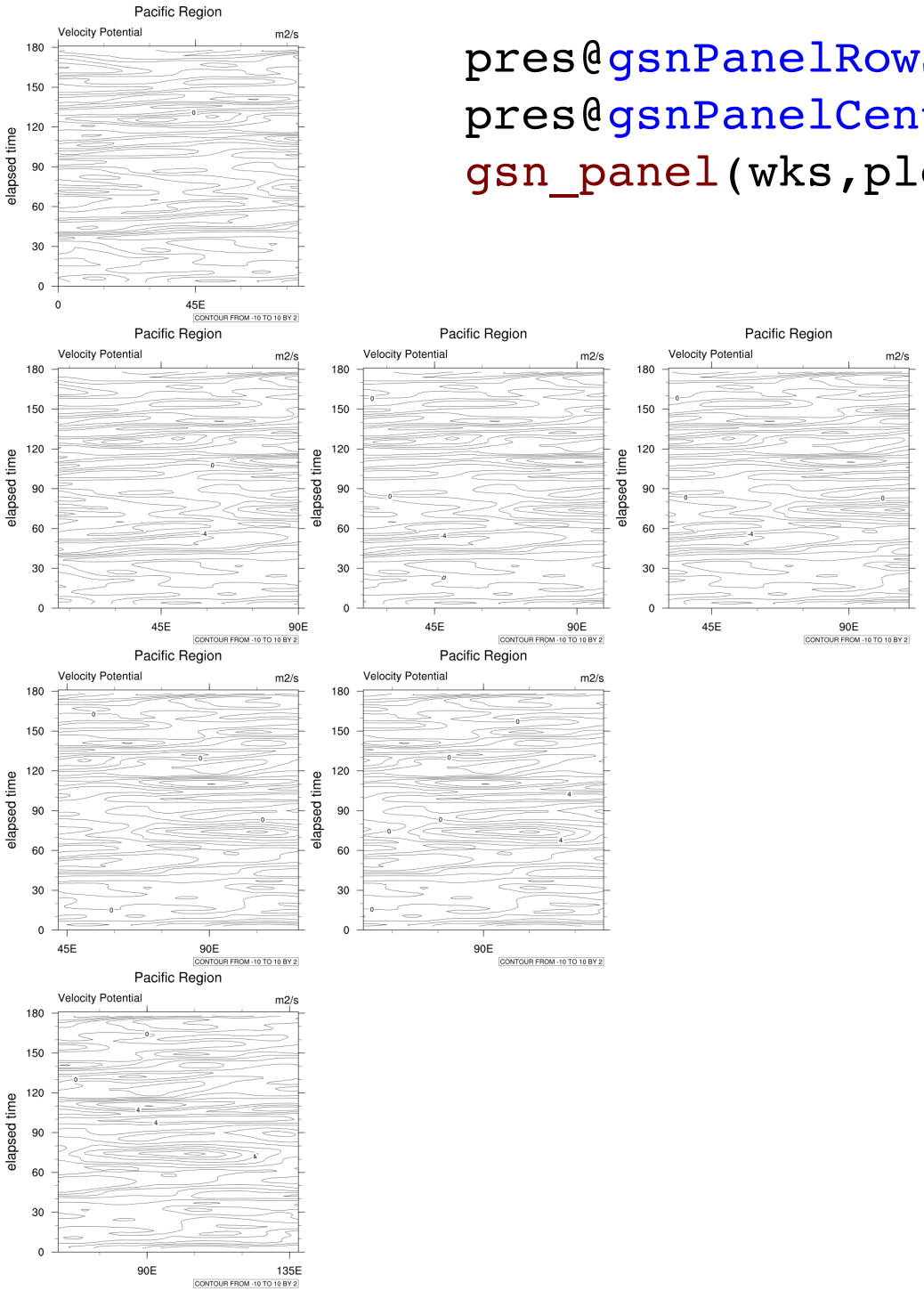


slp_three_panels.ncl



```
pres@gsnPanelRowSpec = True
gsn_panel(wks,plots,(/1,3,2,1/),pres
```






```
pres@gsnPanelRowSpec = True
pres@gsnPanelCenter  = False
gsn_panel(wks,plots,(/1,3,2,1/),pres
```

Resources useful with gsn_panel	
gsnPanelLabelBar	Turn on panel labelbar
txString	Add title for paneled plots
gsnPanelFigureStrings	Add figure captions
gsnPanelScalePlotIndex	Index of plot to use for scaling all plots
gsnMaximize	Maximize paneled plots in frame
gsnPanelBottom / gsnPanelTop / gsnPanelLeft / gsnPanelRight	Control location of paneled plots in unit square
gsnPanelXWhiteSpacePercent / gsnPanelYWhiteSpacePercent	Control amount of white space between plots in a panel

Functions / procedures useful with gsn_panel	
gsn_create_labelbar	Create a custom labelbar
gsn_create_legend	Create a custom legend
gsn_legend_ndc	Draw a custom legend using NDC coordinates
gsn_labelbar_ndc	Draw a custom labelbar using NDC coordinates
drawNDCGrid	Draw NDC grid (for debugging purposes)

More advanced paneling

- See "panels" examples page:

  NCL Home Page -> Examples -> *browser search* "panel"

  http://www.ncl.ucar.edu/Applications/panel.shtml

- See list of every example that "gsn_panel" call appears in:

  NCL Home Page -> Examples

  [List of tips, resources, functions/procedures, and the examples they appear in.]

  http://www.ncl.ucar.edu/Applications/func_list.shtml

Questions? ncl-talk@ucar.edu

http://mailman.ucar.edu/mailman/listinfo/ncl-talk

NCAR Mesa Lab
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