

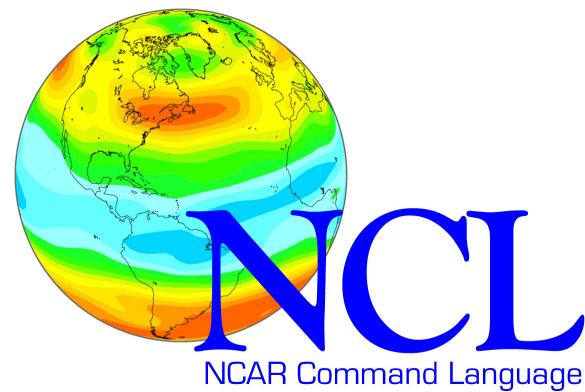
Introduction to NCL Graphics

Primitives

Part V in the series

November 19, 2014

Mary Haley



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Science Foundation*

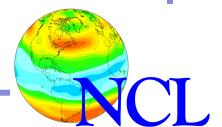
You may want to bookmark this link

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

NCL Home Page -> Intro to NCL Graphics Webinars -> Webinar #5

The screenshot shows the NCAR Command Language (NCL) website. The header includes links for NCAR, CISL, VETS, NCL, Examples, Functions, Resources, Popular Links, What's New, Support, External, Download, and Contributors. The main content area features several graphics: a world map with a color scale, a scatter plot of standardized deviation (Percentile) vs. REF, a bathymetry map of the US, a map of the US with state boundaries, a time series plot from 1920 to 2000, and a contour plot of radio wind reports. To the left, a column of text describes NCL's features: it's an interpreted language for scientific data analysis and visualization, portable and free, supports various file formats like netCDF3/4, GRIB1/2, HDF-SDS, and shapefiles, has built-in analysis functions, creates high-quality graphics, and includes example scripts. A large orange arrow points from the text "Many example scripts and their corresponding graphics are available" towards the bottom right of the page. On the right side, there's a "Release Information" box stating the current version is 6.2.1 (released September 2, 2014), an "Announcements" box mentioning a rescheduled webinar ("Introduction to NCL Graphics" rescheduled for Nov 18 & 19), and a "Citing NCL" box. At the bottom, there's a copyright notice for 2014 UCAR and links for Privacy Policy, Terms of Use, Contact the Webmaster, and Sponsored by NSF.

Introduction to NCL Graphics



About this series

- Fifth 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
- paneling (previous webinar)
- NCL/NetCDF data model
- UNIX

Outline

- What are primitives?
- Gallery
- Functions for drawing primitives
- Demos
- Tips

What are primitives?

- Primitives include:
 - lines
 - markers
 - polygons
 - text
- You can draw primitives on:
 - any existing plot that has a “data space”
(contour, vector, streamline, XY, map plot)
 - the NDC unit square
- Primitives have their own set of resources

Outline

- What are primitives?
- **Primitives gallery**
- Functions for drawing primitives
- Demos
- Tips

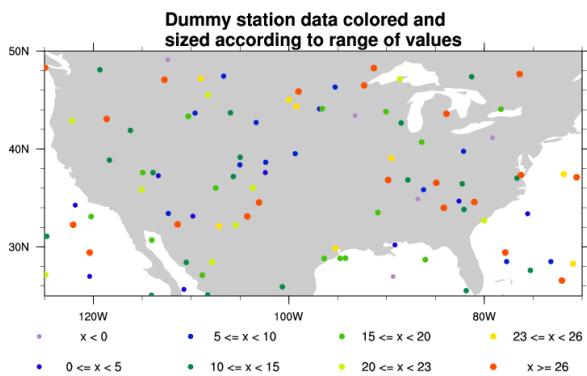
Primitives gallery

- Many of these images can be found with full scripts on many of our examples page:

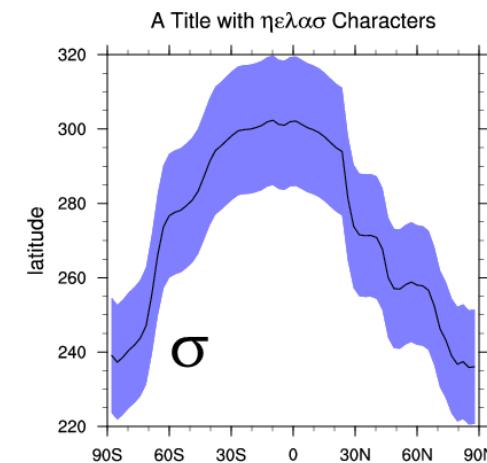
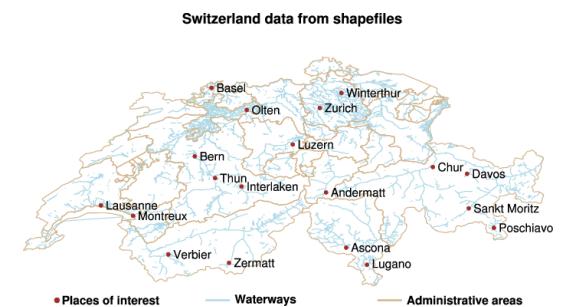
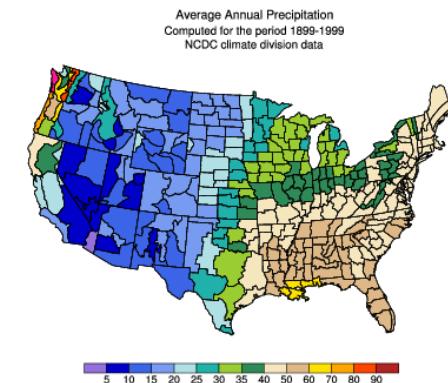
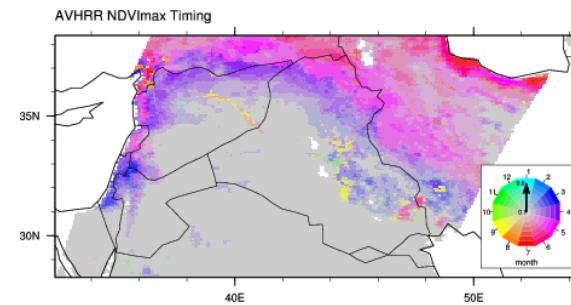
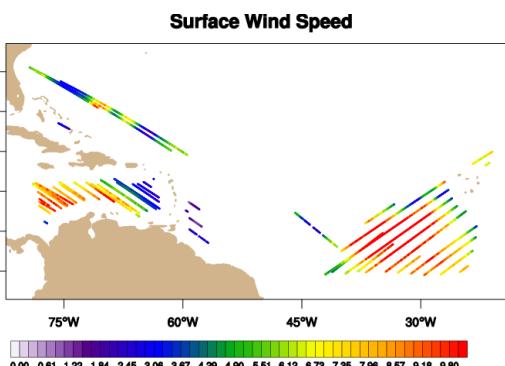
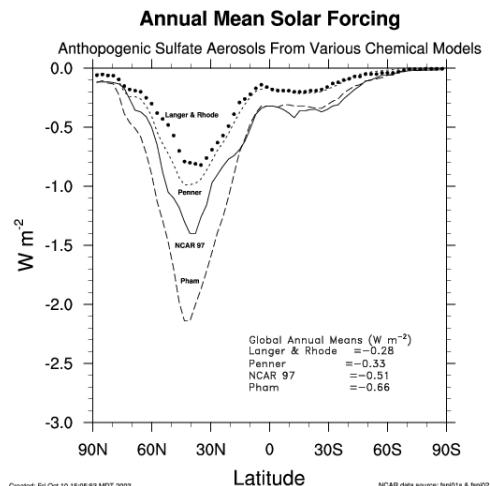
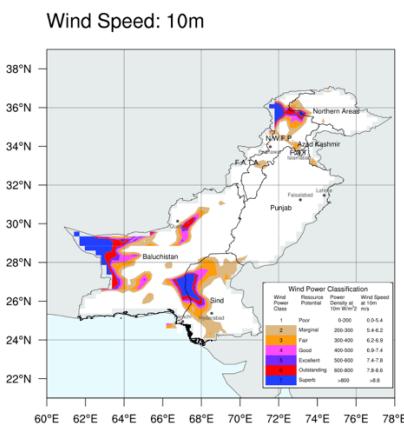
<http://www.ncl.ucar.edu/Applications/>

- If you see one you like, make a note of it. I can point you to the full script, or help you create it later.

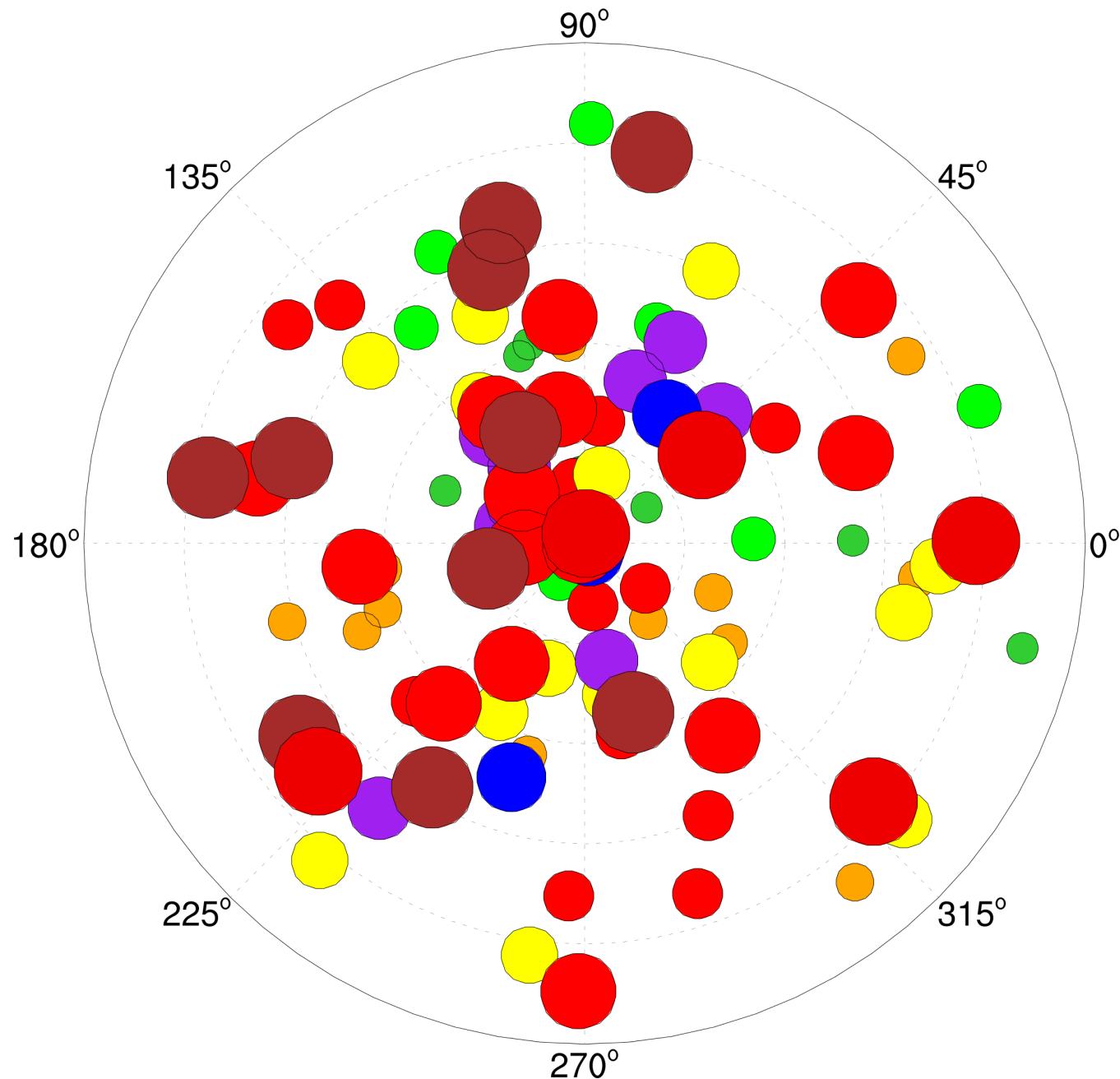
Primitives are
markers, lines,
polygons, and text
used to further
annotate a plot



2005-10-11_17:24:27



Radial background with markers

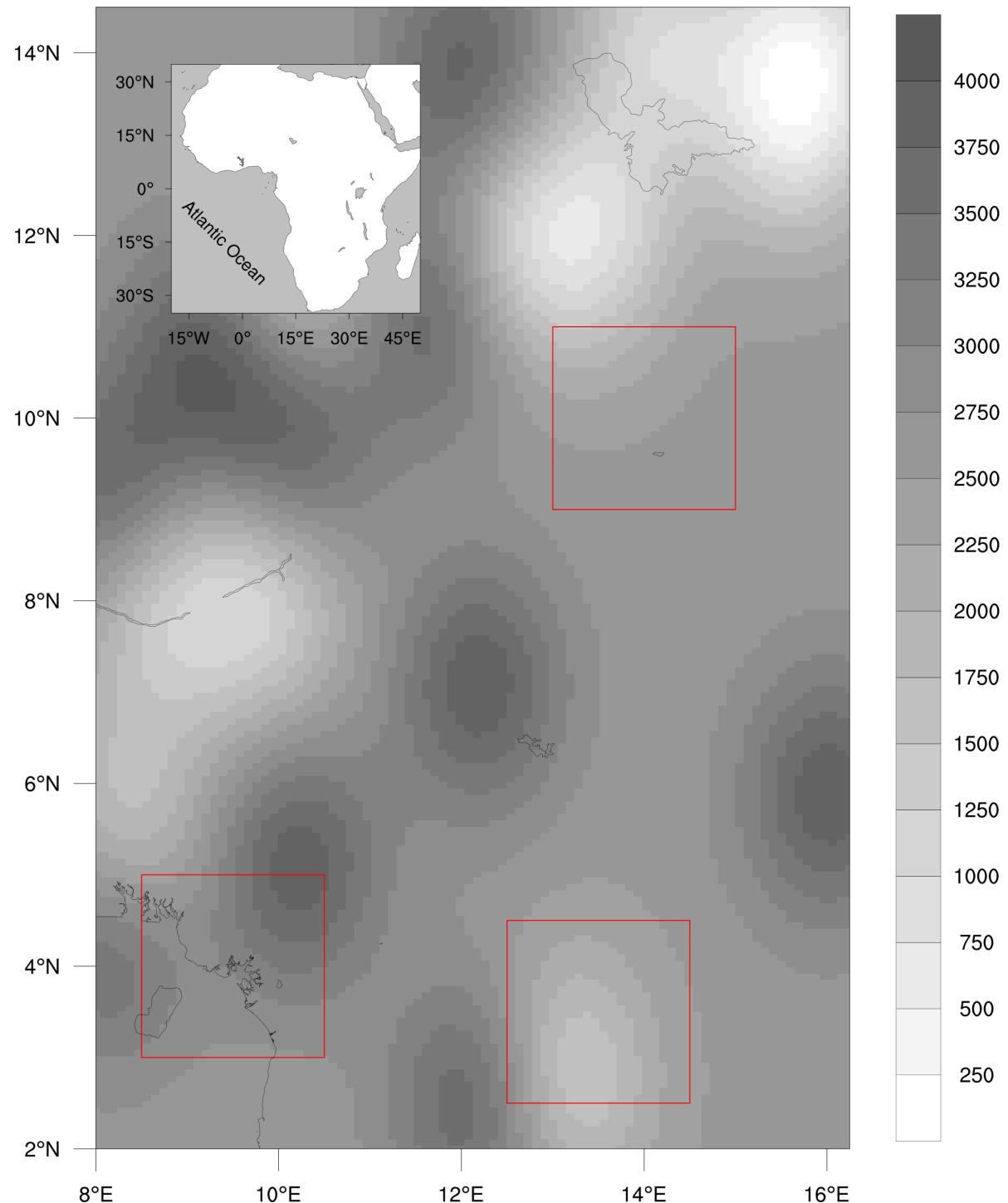


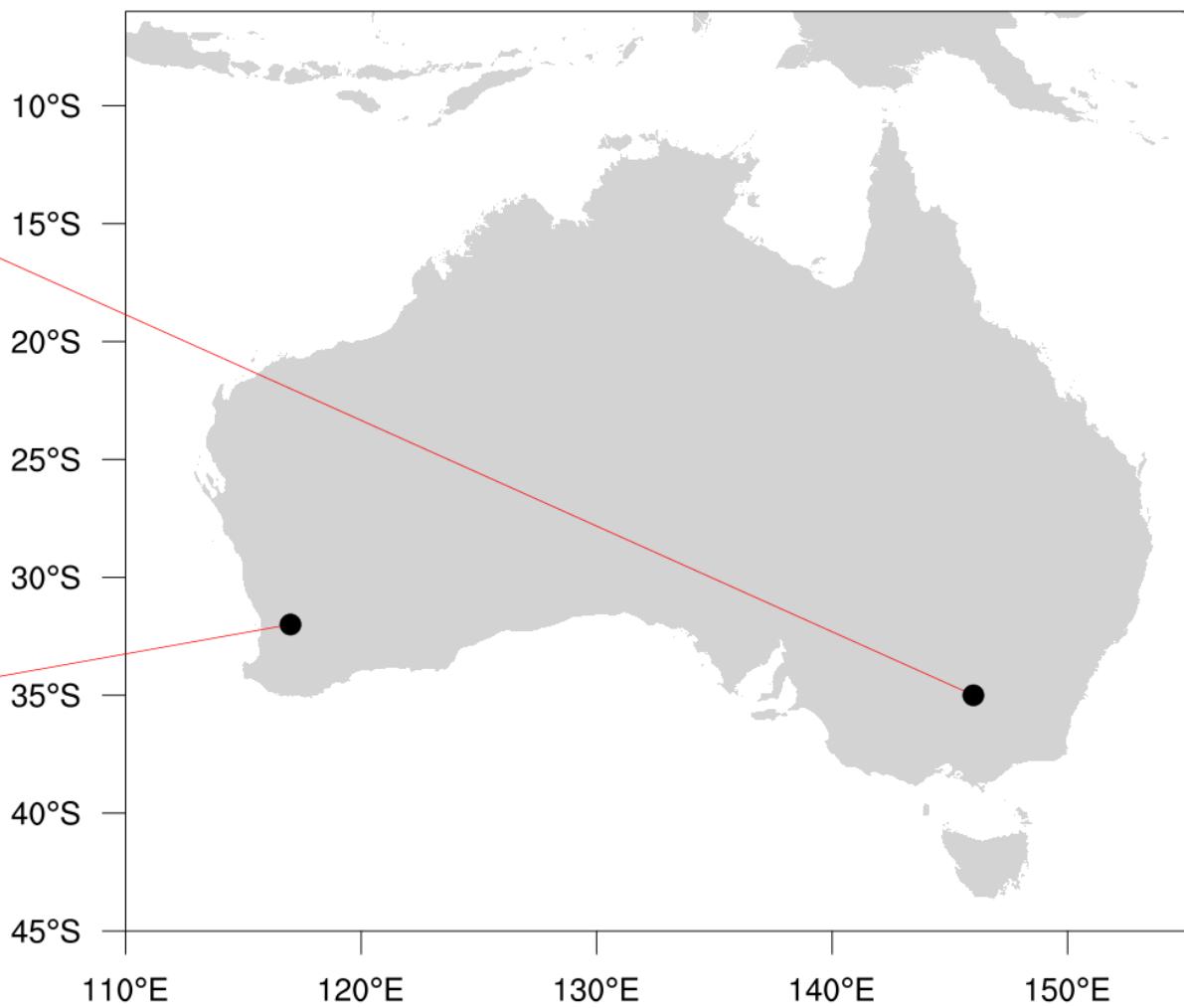
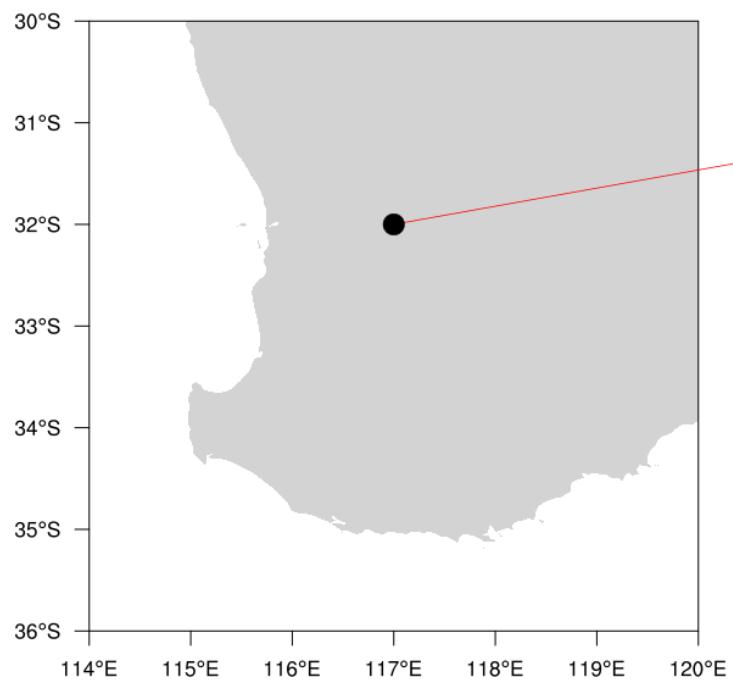
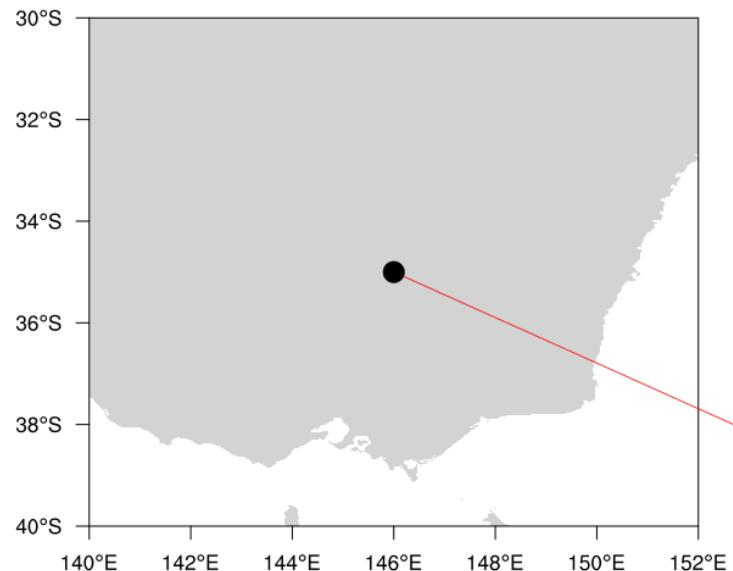
Legend for lithology colors

unconsolidated material	shale	bimodal suite	quartz syenite	greenschist
alluvium	black shale	felsic volcanic rock	syenite	blueschist
silt	oil shale	alkali-feldspar rhyolite	quartz monzonite	mica schist
sand	argillite	rhyolite	monzonite	pelitic schist
flood plain	siltstone	rhyodacite	gabbro	quartz-feldspar schist
gravel	fine-grained mixed clastic rock	dacite	quartz monzogabbro	calc-silicate schist
levee	sandstone	alkali-feldspar trachyte	monzogabbro	amphibole schist
delta	arenite	trachyte	quartz gabbro	granofels
alluvial fan	orthoquartzite	quartz latite	gabbro	gneiss
alluvial terrace	calcarenite	latite	norite	felsic gneiss
lake or marine sediment	arkose	intermediate volcanic rock	troctolite	granitic gneiss
playa	wacke	trachyandesite	anorthosite	biotite gneiss
mud flat	graywacke	andesite	alkalic intrusive rock	mafic gneiss
beach sand	medium-grained mixed clastic rock	mafic volcanic rock	nepheline syenite	orthogneiss
terrace	conglomerate	trachybasalt	ultramafic intrusive rock	paragneiss
eolian material	sedimentary breccia	basalt	peridotite	migmatite
dune sand	coarse-grained mixed clastic rock	tholeiite	dunit	amphibolite
sand sheet	olistostrome	hawaiite	kimberlite	granulite
loess	m***lange	alkaline basalt	pyroxenite	tectonite
volcanic ash	carbonate rock	alkalic volcanic rock	hornblendite	tectonic m***lange
mass wasting material	limestone	phonolite	intrusive carbonatite	tectonic breccia
colluvium	dolostone	tephrite	metamorphic rock	cataclasite
mudflow	mixed carbonate/clastic rock	ultramafitite	hornfels	phyllonite
lahar	mixed volcanic/clastic rock	volcanic carbonatite	eclogite	mylonite
debris flow	phosphorite	plutonic rock	greisen	flaser gneiss
landslide	chemical sedimentary rock	aplite	skarn	augen gneiss
talus	evaporite	porphyry	calc-silicate rock	ice
glacial drift	chert	lamprophyre	serpentinite	water
till	novaculite	pegmatite	metasedimentary rock	
moraine	iron formation	granitoid	meta-argillite	
stratified glacial sediment	exhalite	alkali-feldspar granite	slate	
glacial outwash sediment	coal	quartz monzodiorite	quartzite	
sub/supra-glacial sediment	mixed coal/clastic rock	monzodiorite	metaconglomerate	
glaciolacustrine sediment	volcanic rock	quartz diorite	marble	
glacial-marine sediment	glassy volcanic rock	diorite	metavolcanic rock	
biogenic material	obsidian	diabase	felsic metavolcanic rock	
peat	vitrophyre	granite	metarhyolite	
coral	pumice	peraluminous granite	keratophyre	
residuum	pyroclastic rock	metaluminous granite	intermediate metavolcanic rock	
clay or mud	tuff	subaluminous granite	mafic metavolcanic rock	
sedimentary rock	welded tuff	peralkaline granite	metabasalt	
clastic rock	ash-flow tuff	granodiorite	spilit	
mudstone	ignimbrite	tonalite	greenstone	
claystone	volcanic breccia	trondhjemite	phyllite	
bentonite	lava flow	alkali-feldspar syenite	schist	

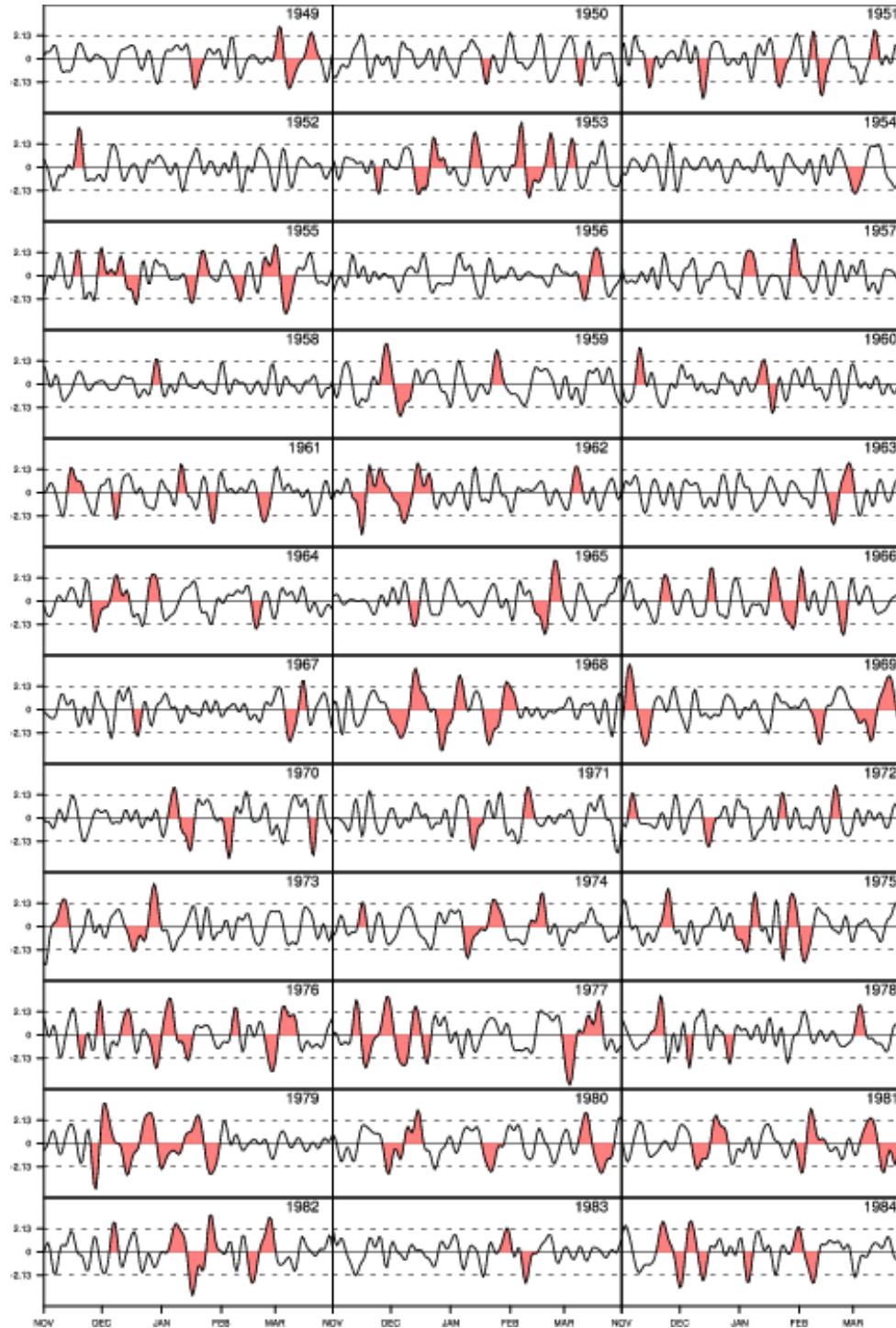
Map plot with red polyline boxes

The little map was added with “[gsn_add_annotation](#)”

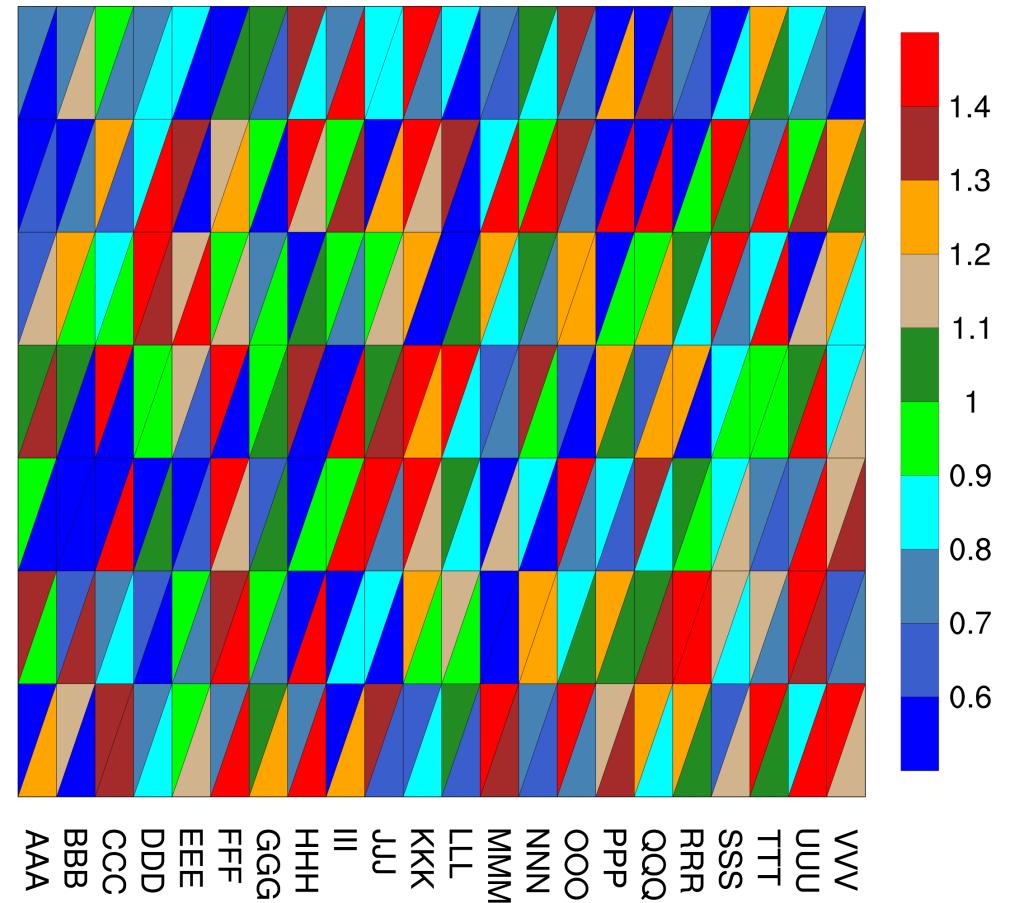
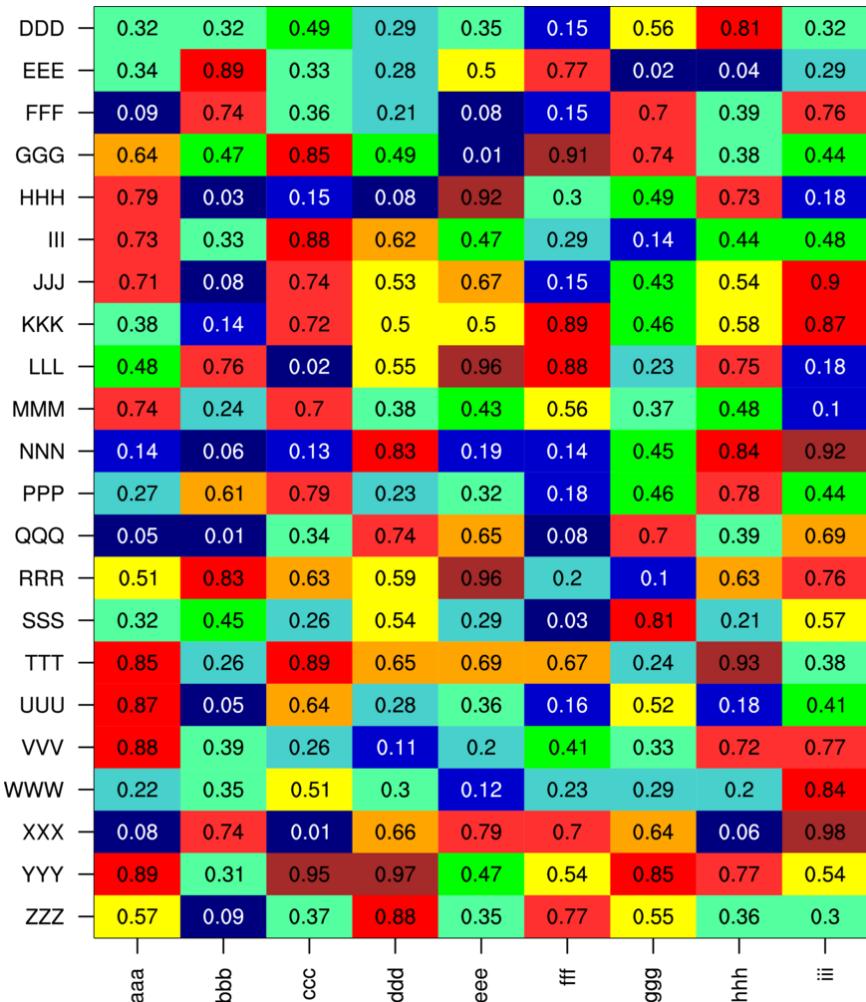




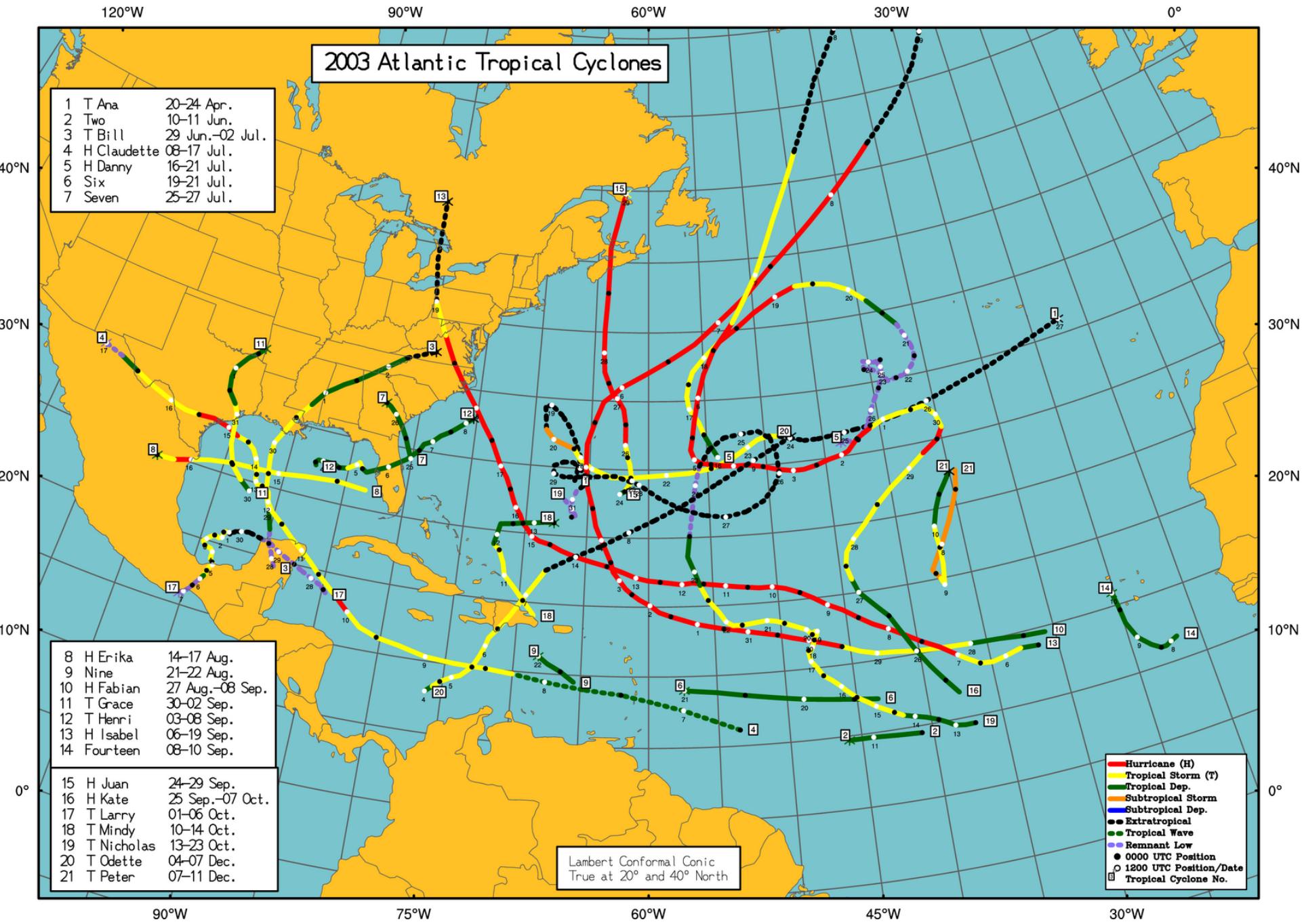
XY plots with filled polygons



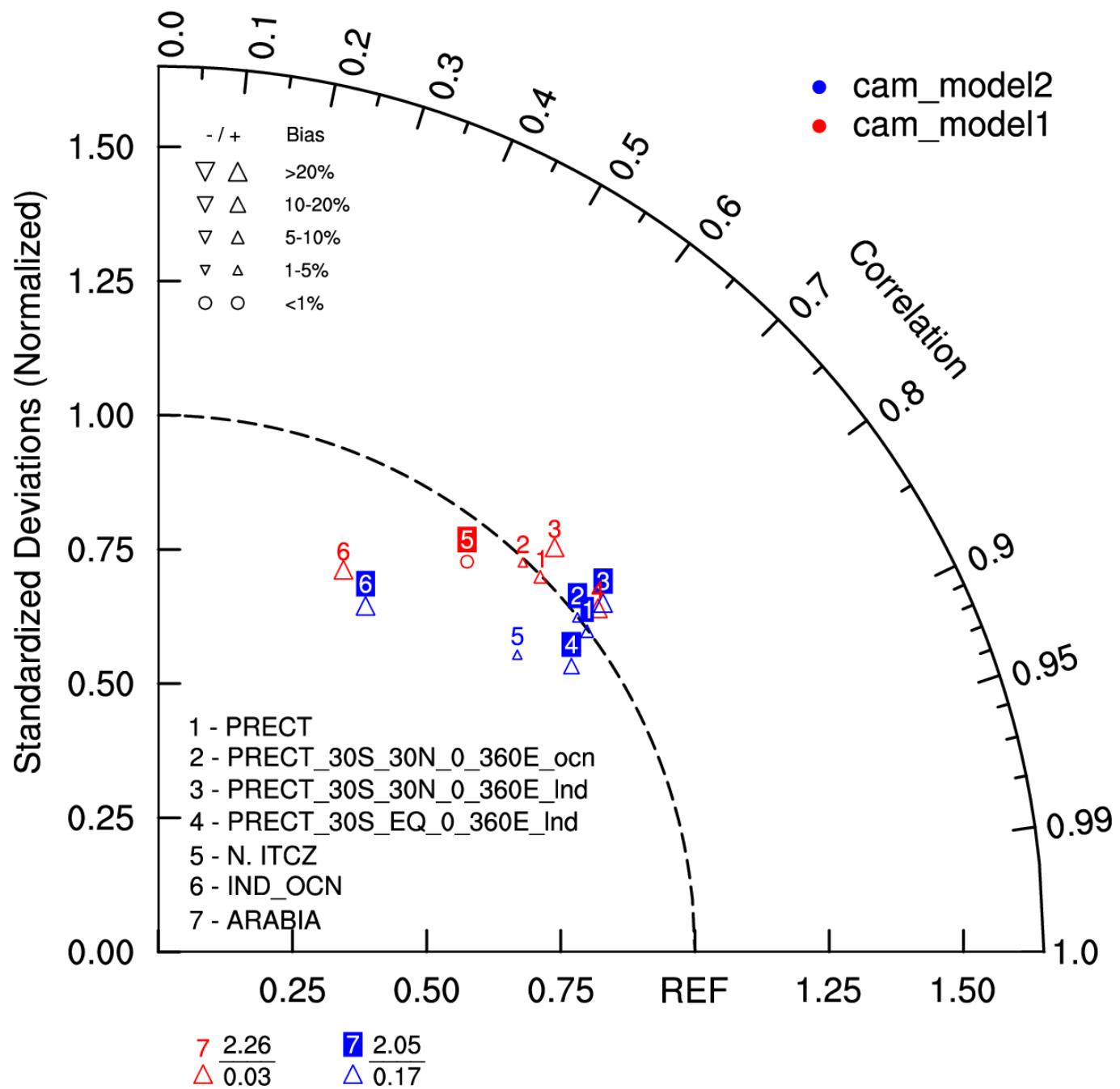
Filled polygons with text



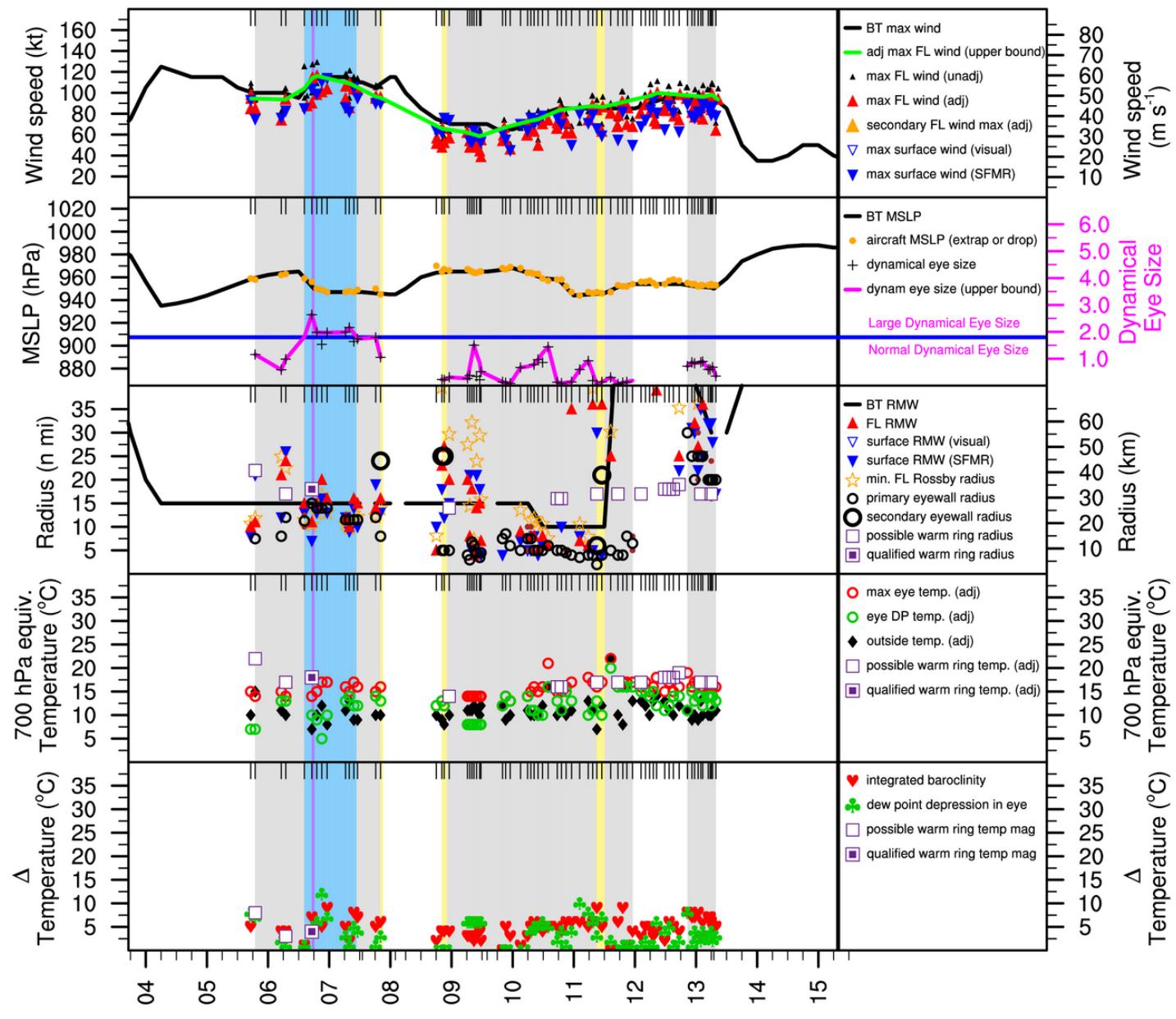
Text, markers, and lines



DJF



IKE (AL092008)



Eye formation period

Eye reported by aircraft

Dynamically-large eye

Date / Time (UTC)

Concentric eyewalls

Warm ring

PROBABILITY THAT CENTER OF ISABEL WILL PASS
WITHIN 75 STATUTE MILES DURING THE 72 HOURS
STARTING AT 8:00 PM EDT TUE SEP 16 2003



0-4%



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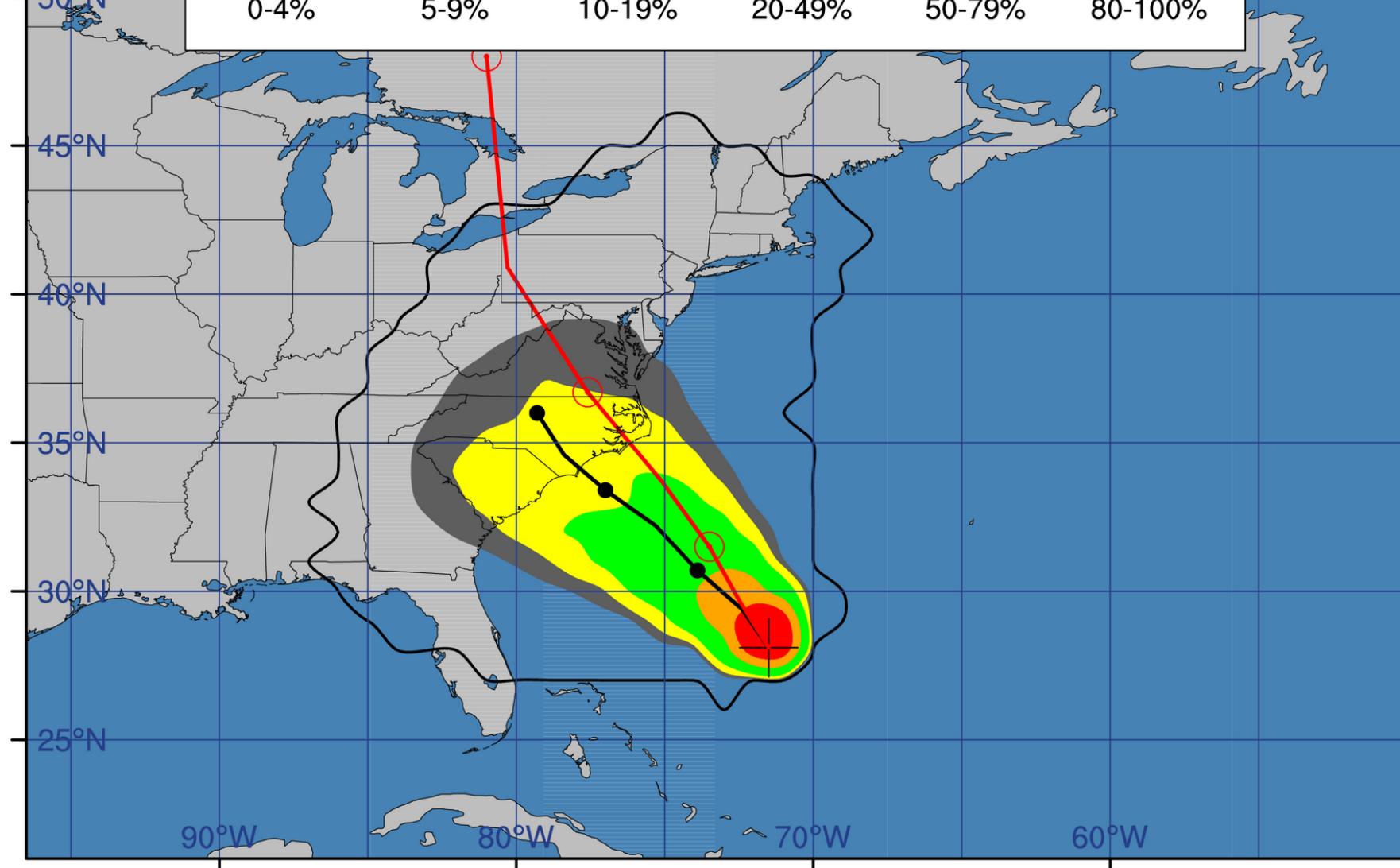
20-49%



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Outline

- What are primitives?
- Primitives gallery
- Functions for drawing primitives
- Demos
- Tips

Three ways to draw primitives

1. By attaching them to an existing plot
2. By drawing them directly on an existing plot
3. By drawing them directly on the “NDC” canvas

1. Attaching primitives to an existing plot

- **Advantage**
 - If plot is resized, primitives are resized too; especially important for paneled plots
- **Disadvantage**
 - Requires a unique id
 - Can be memory intensive if you have a lot of primitives

2. Drawing primitives directly on plot

- **Advantage**
 - Doesn't require an id
 - Can run faster (less memory intensive)
- **Disadvantage**
 - Primitives don't “stay” with the plot

3. Drawing primitives directly on “NDC” canvas

- The only method available if need to draw primitives outside of the plot area
- No easy way to attach these types of primitives
- If trying to add a “legend” to a plot, see:
 - `gsn_create_labelbar`
 - `gsn_create_legend`
 - `gsn_create_text`

1. Primitive drawing <i>functions</i> (attaching to a plot)	
<code>gsn_add_polyline</code>	Add a line to a plot using plot coordinates
<code>gsn_add_polymarker</code>	Add markers to a plot using plot coordinates
<code>gsn_add_polygon</code>	Add a polygon to a plot using plot coordinates
<code>gsn_add_text</code>	Add text strings to an existing plot

2. Primitive drawing <i>procedures</i> (drawing directly on a plot)	
<code>gsn_polyline</code>	Draw a line on a plot using plot coordinates
<code>gsn_polymarker</code>	Draw markers on a plot using plot coordinates
<code>gsn_polygon</code>	Draw a polygon on a plot using plot coordinates
<code>gsn_text</code>	Draw text strings on a plot using plot coordinates

3. Primitive drawing <i>procedures</i> (outside a plot, using NDC coordinates)	
<code>gsn_polyline_ndc</code>	Draw a line on the canvas using NDC coordinates
<code>gsn_polymarker_ndc</code>	Draw markers on the canvas using NDC coordinates
<code>gsn_polygon_ndc</code>	Draw a polygon on the canvas using NDC coordinates
<code>gsn_text_ndc</code>	Draw text strings on the canvas using NDC coordinates

Other useful functions and procedures	
<code>drawNDCGrid</code>	Draws NDC grid (for use with NDC primitives)
<code>gsn_create_text</code>	Create a text string
<code>gsn_create_labelbar</code>	Create a labelbar
<code>gsn_create_legend</code>	Create a legend
<code>gsn_add_annotation</code>	Attach a graphical object to another – can be quite powerful!

Shapefile functions (these use primitives under the hood)	
<code>gsn_add_shapefile_polylines</code>	Add shapefile outlines to a map
<code>gsn_add_shapefile_polymarkers</code>	Add shapefile points to a map
<code>gsn_add_shapefile_polygons</code>	Add shapefile polygons to a map

Resources useful with polyline drawing routines	
gsLineColor	Line color (default foreground color)
gsLineThicknessF	Line thickness (default 1.0)
gsLineDashPattern	Line dash pattern (default solid)
Resources useful with polymarker drawing routines	
gsMarkerColor	Marker color (default foreground color)
gsMarkerIndex	Marker index (default asterisk)
gsMarkerSizeF	Marker size (default ?)
gsMarkerThicknessF	Marker thickness (useful for non-filled markers)
Resources useful with polygon drawing routines	
gsFillColor	Fill color (default transparent)
gsFillOpacityF	Fill opacity (default 1.0)
gsFillIndex	Fill index (for pattern fill)
gsEdgesOn	Turn on polygon outline
gsEdgeColor	Color of polygon outline, if turned on
Resources useful with text drawing routines	
txFontColor	Font color (default foreground)
txFontHeightF	Font height
txPerimOn	Turn on text box perimeter
Lines, markers, and polygons all use “GraphicStyle” (“gs”) resources. Text uses “TextItem” (“tx”) resources	

Outline

- What are primitives?
- Primitives gallery
- Functions for drawing primitives
- Demos
- Tips

Demo #1

- Start with “prim1a.ncl” script
- Scripts (prim1x.ncl) and data file available from:

NCL Home Page -> Support -> Webinars -> NCL Graphics

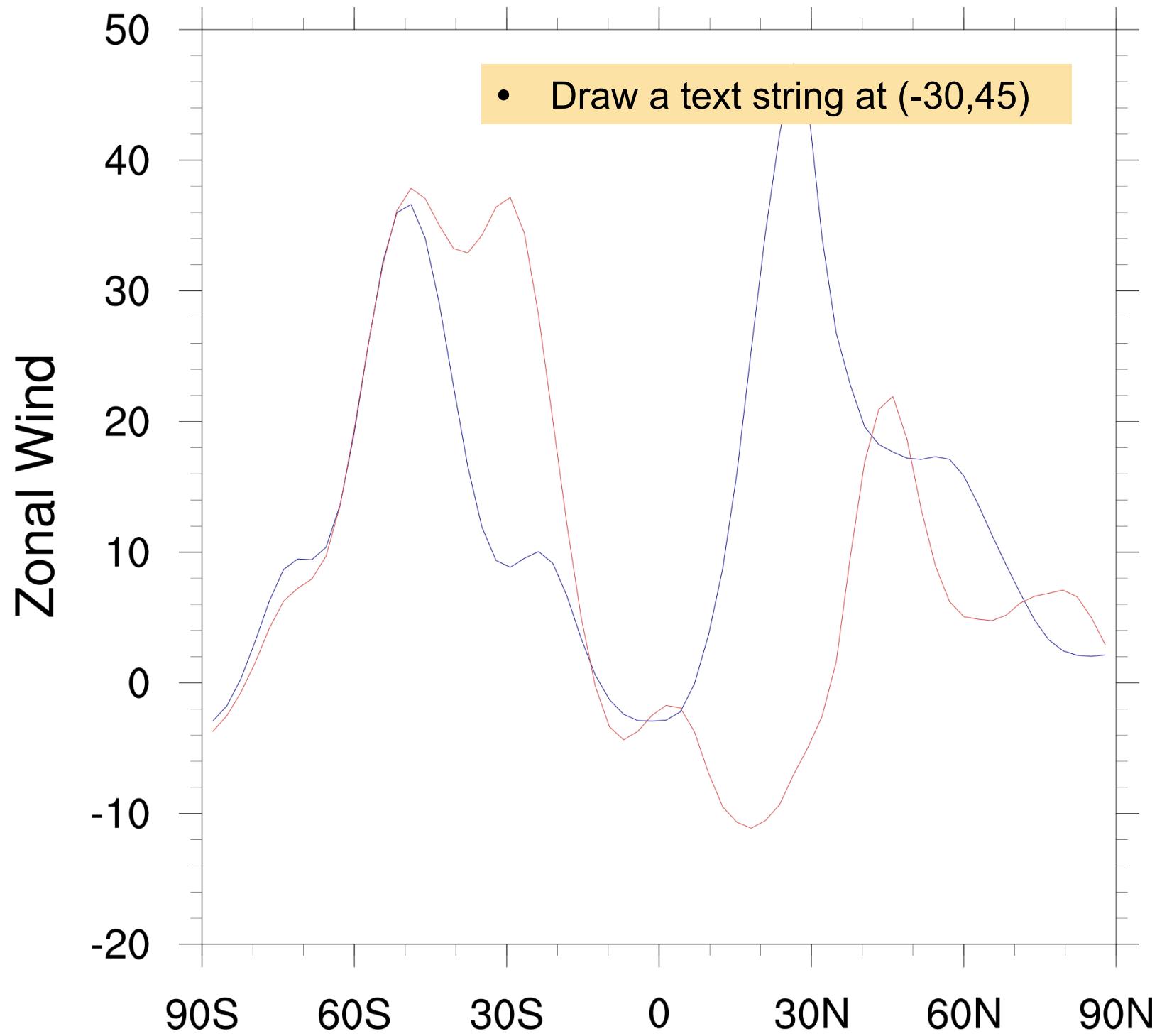
http://www.ncl.ucar.edu/Training/Webinars/NCL_Graphics/PrimitivesDemo

```
f = addfile ("uv300.nc","r")
u = f->U      ; read U

wks    = gsn_open_wks ("x11","prim1a")

res          = True
res@xyMonoDashPattern = True      ; use solid lines only
res@xyLineColors     = (/ "NavyBlue", "Brown3" /)
res@xyLineThicknessF = 2.0

lon = 82      ; Which longitude to select
plot = gsn_csm_xy (wks,u&lat,u(:,:,lon),res)
```



```

f = addfile ("uv300.nc","r")
u = f->U      ; read U

wks  = gsn_open_wks ("x11","prim1f")

res           = True
res@gsnDraw   = False
res@gsnFrame  = False
res@xyMonoDashPattern = True
res@xyLineColors = (/ "NavyBlue", "Brown3" /)
res@xyLineThicknessF = 2.0
res@trYMinF   = min(u)
res@trYMaxF   = max(u)

lon1 = 70
plot1 = gsn_csm_xy (wks,u&lat,u(:,:,lon1),res)      ; Create plots at different longitudes
lon2 = 0
plot2 = gsn_csm_xy (wks,u&lat,u(:,:,lon2),res)

lonstr1 = "lon = " + lon1                                ; Create longitude strings to add to plot
lonstr2 = "lon = " + lon2

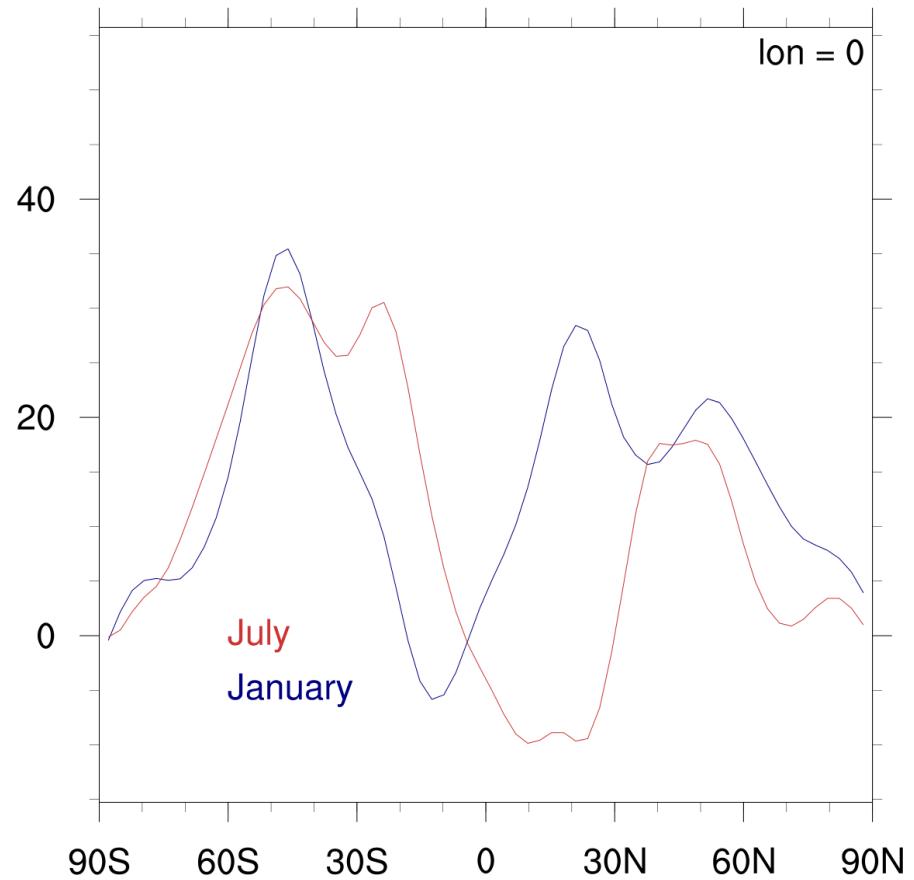
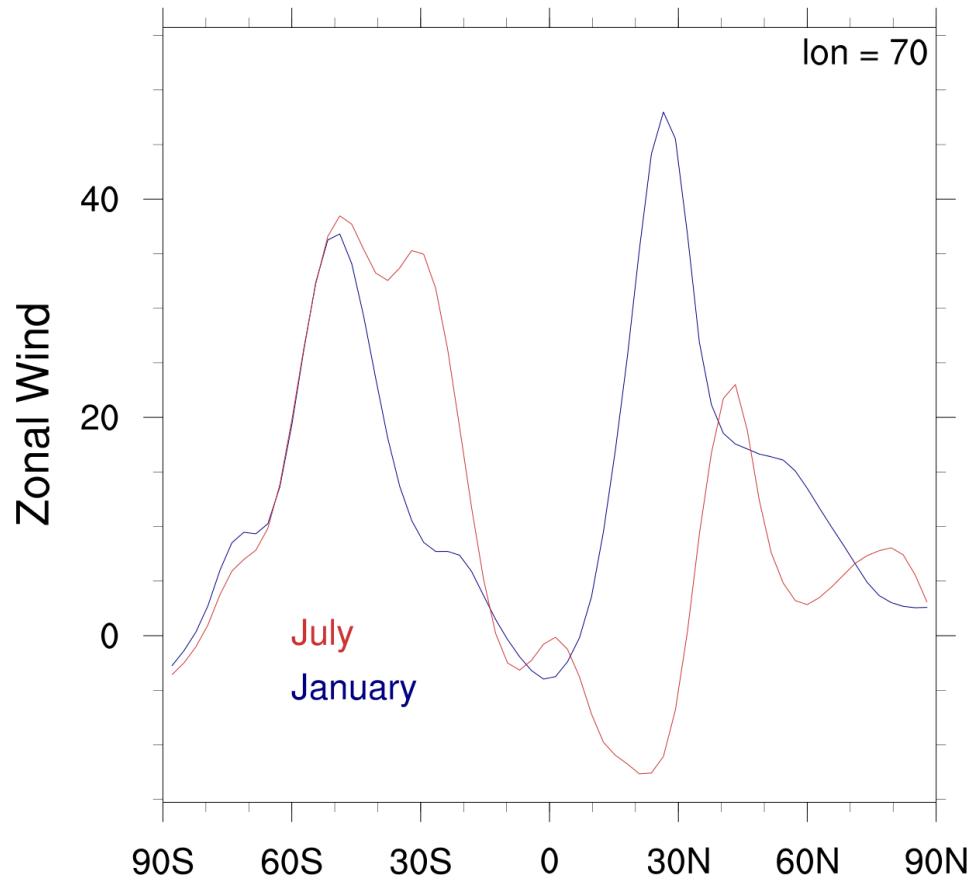
txres        = True
txres@txFontHeightF = 0.02
txres@txJust   = "TopRight"
id = gsn_add_text(wks,plot1,lonstr1,max(u&lat),max(u)-1,txres) ; Attach longitude strings
id = gsn_add_text(wks,plot2,lonstr2,max(u&lat),max(u)-1,txres)

txres@txJust   = "CenterLeft"
txres@txFontColor = "NavyBlue"
id = gsn_add_text(wks,plot1,"January",-60,-5,txres)       ; Attach month strings
id = gsn_add_text(wks,plot2,"January",-60,-5,txres)

txres@txFontColor = "Brown3"
id = gsn_add_text(wks,plot1,"July",-60,0,txres)
id = gsn_add_text(wks,plot2,"July",-60,0,txres)

pres = True
gsn_panel(wks,(/plot1,plot2/),(/1,2/),pres)            ; Panel plots

```



Demo #2

- Start with “prim2c.ncl” script
- Scripts (prim2x.ncl) and data file available from:

NCL Home Page -> Support -> Webinars -> NCL Graphics

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

- Australia administrative shapefiles available from:

<http://www.gadm.org/country>

```

wks = gsn_open_wks("x11","prim2c")
res                      = True
res@gsnDraw               = False
res@gsnFrame              = False

res@mpDataBaseVersion     = "MediumRes" ; Medium resolution
res@mpDataSetName         = "Earth..4"   ; Better outlines

res@mpLimitMode           = "LatLon"
res@mpMinLatF             = -45          ; Zoom in on Australia
res@mpMaxLatF             = -10
res@mpMinLonF              = 112
res@mpMaxLonF              = 155
res@mpFillOn               = False        ; Turn off map fill

map = gsn_csm_map(wks,res)      ; Create map

cities = (/ "Adelaide", "Perth", "Brisbane", "Melbourne", "Sydney" /)
lat    = (/     -34.93,   -31.95,     -27.47,     -37.81,   -33.86 /)
lon    = (/     138.60,   115.86,    153.03,    144.96,   151.21 /)

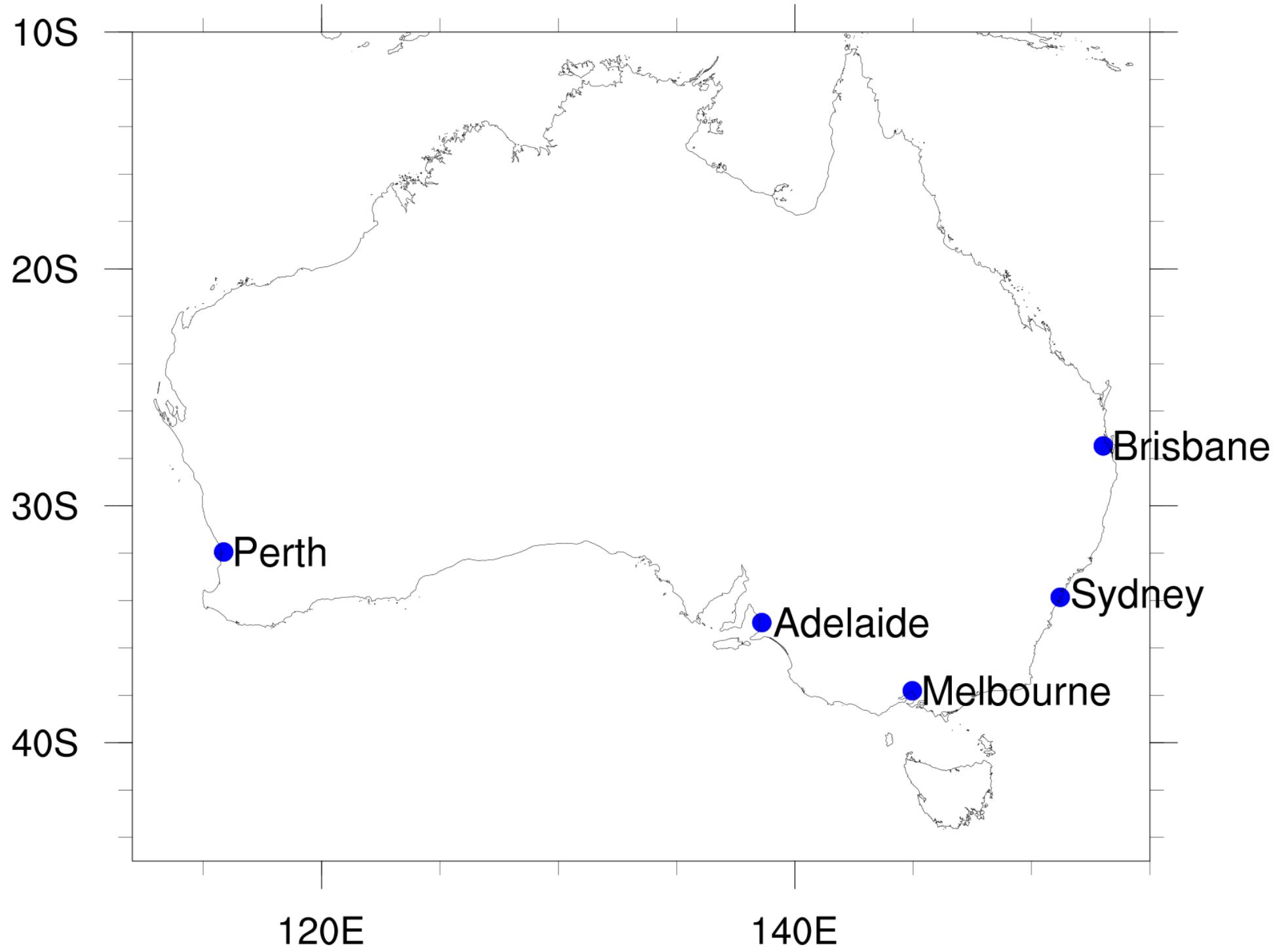
;---Attach markers to map.
mres                  = True
mres@gsMarkerSizeF = 10.          ; Make markers larger
mres@gsMarkerColor  = "blue"
mres@gsMarkerIndex   = 16          ; Filled dot
dum1 = gsn_add_polymarker(wks,map,lon,lat,mres)

;---Attach text to map.
tres                  = True
tres@txFontHeightF = 0.015        ; Default is large
tres@txJust         = "CenterLeft" ; default is "CenterCenter"

dum2 = gsn_add_text(wks,map,cities,lon+0.5,lat,tres)

draw(map)    ; Drawing the map draws the markers
frame(wks)   ; Advance the frame

```



Outline

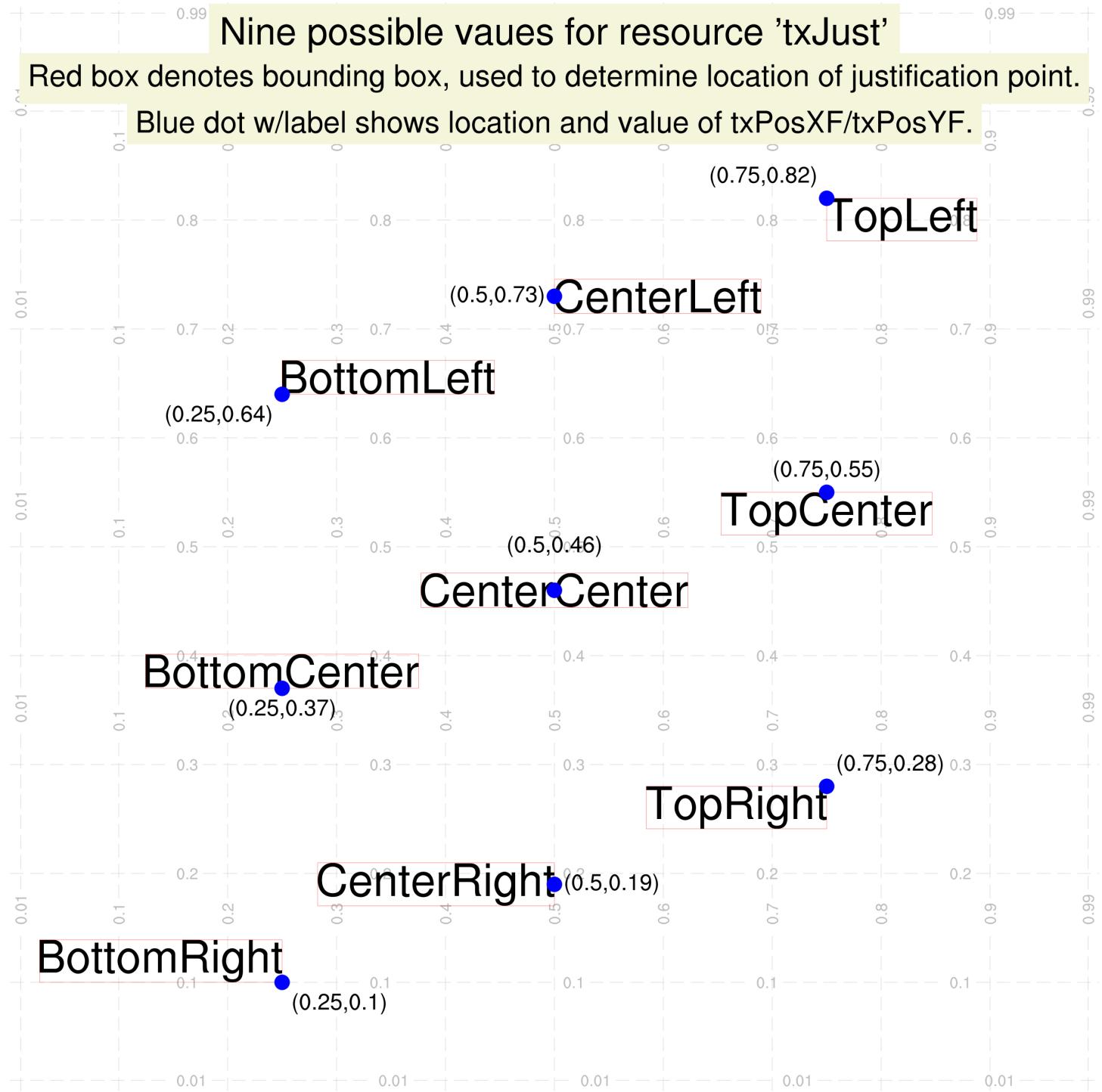
- What are primitives?
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Tips for drawing primitives

- `gsn_add_polyxxx` generally preferred over `gsn_polyxxx`
- Be sure to use unique id's if using `gsn_add_polyxxx`
- If drawing a lot of primitives, then `gsn_polyxxx` may be better. Check out the new “`gsSegments`” resource
- Use “`txJust`” resource to control positioning of text
- Use “`drawNDCGrid`” procedure to help with drawing primitives on the canvas

Illustrates use
of "txJust"

Example
"text_13.ncl"
on "text"
examples page



If primitives not showing up

- Are x,y are in correct data space?
- Are x,y location arguments in correct order?
Common mistake is using “lat,lon” order for map coordinates; it should be “lon,lat”.
- Make sure you are drawing things in the right order
(i.e. drawing the primitives *after* you draw the plot).
- May need to use one of the “[DrawOrder](#)” resources
[mpOutlineDrawOrder](#), [xyCurveDrawOrder](#), [cnFillDrawOrder](#), etc

If primitives taking a long time to draw

- If using `gsn_add_polyxxx`, then this can be expensive memory-wise. Consider using `gsn_polyxxx`.
- If drawing lines or polygons, then “`gsSegments`” can significantly speed things up.

To create legends / labelbars

- Use `gsn_create_labelbar` or `gsn_create_legend` with `gsn_add_annotation` to attach to an existing plot
- Use `gsn_labelbar_ndc` or `gsn_legend_ndc` to draw on the canvas somewhere
- Use primitive drawing routines if need more customization

Where to learn more

- Examples page:
<http://www.ncl.ucar.edu/Applications/>
- In particular:
 - “Polygons”, “Polylines”, “Polymarkers”
 - “Annotations”
 - “Text”
 - “Legends”, “Labelbars”
 - “Draw order”
- List of functions and every example 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
November 13, 2014