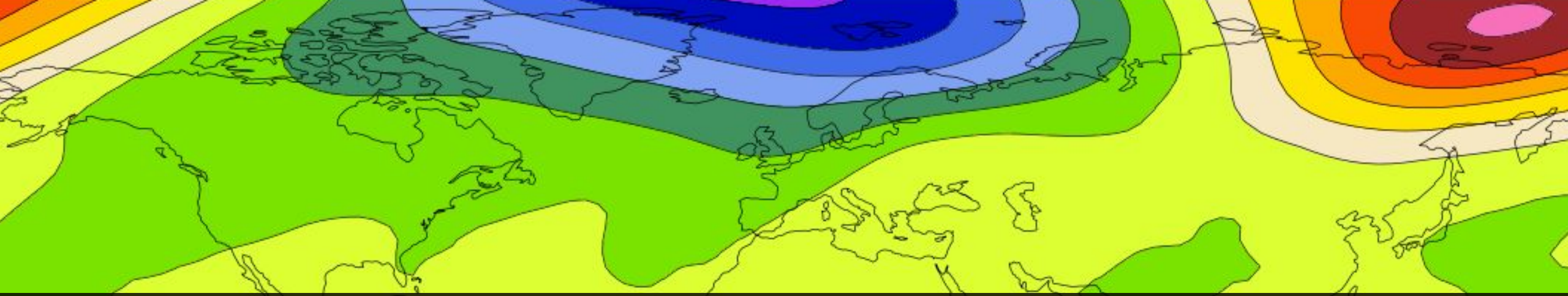

Expanding and Strengthening the Transition from NCL to Python Visualizations

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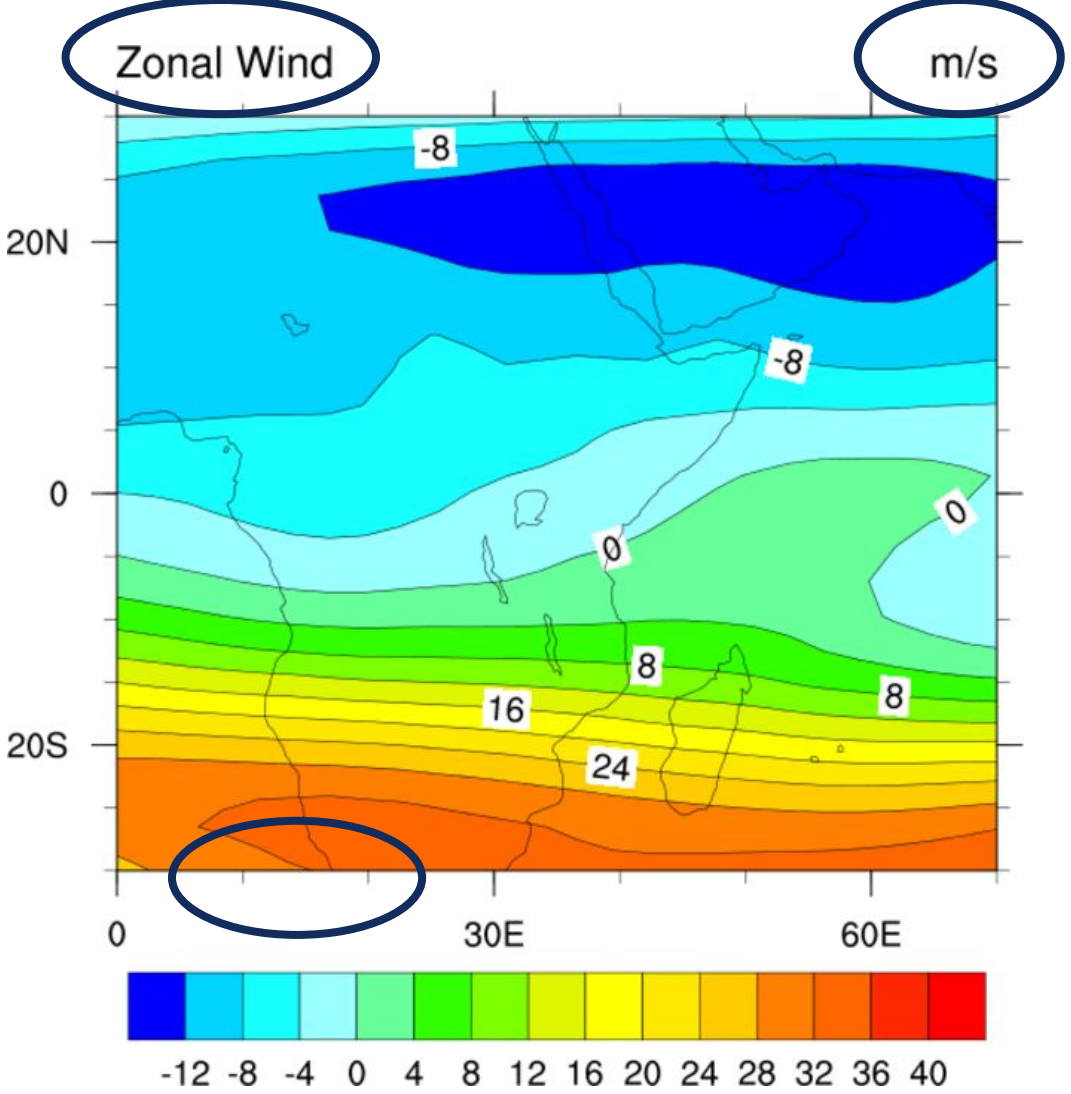
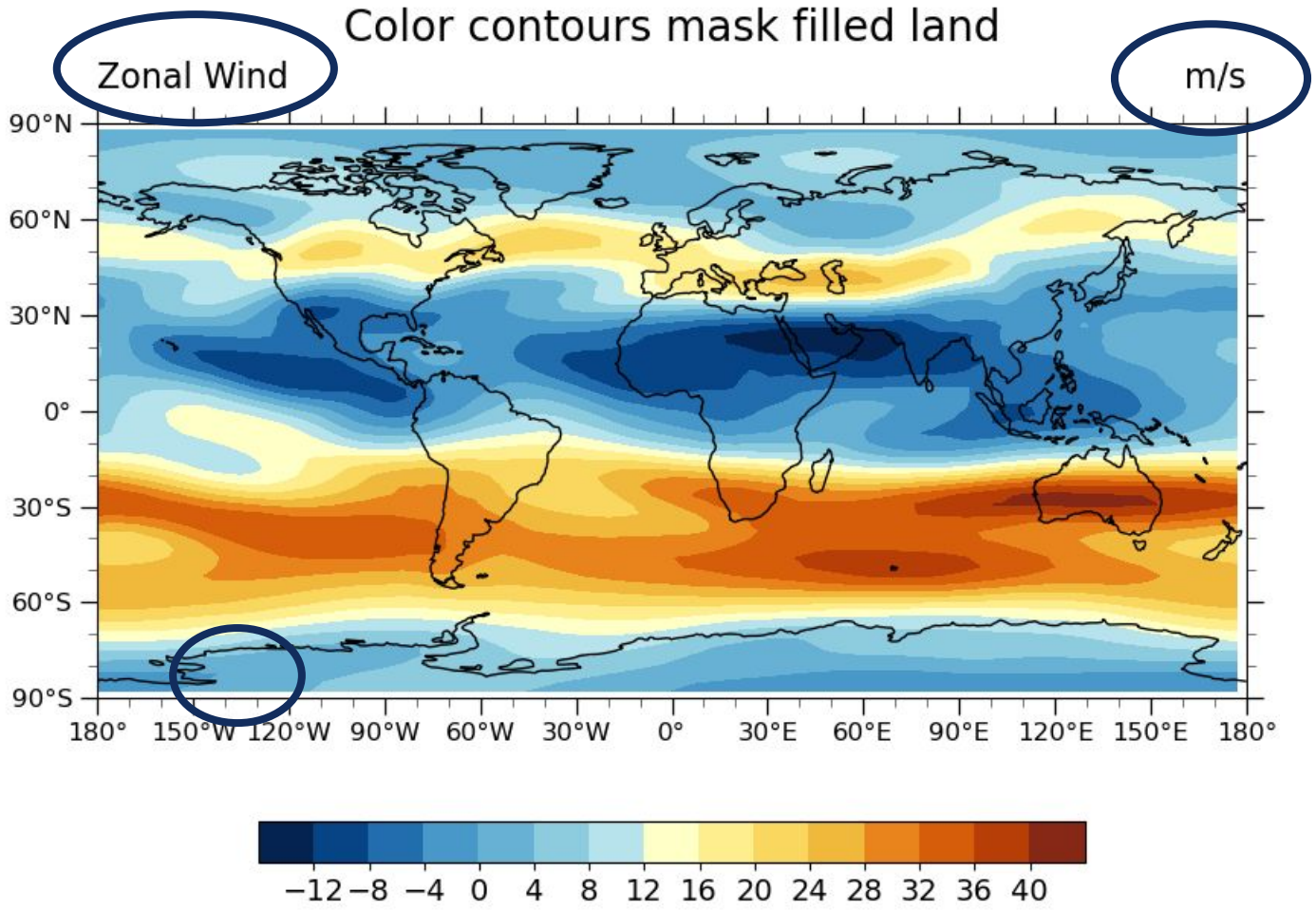
July 27, 2021

This material is based upon work supported by the National Center for Atmospheric Research, which is a major facility sponsored by the National Science Foundation under Cooperative Agreement No. 1852977.


Zonal Wind
m/s
20N
0
20S
0
30E
60E
-8
-8
0
0
8
8
16
24
-12 -8 -4 0 4 8 12 16 20 24 28 32 36 40


Color contours mask filled land
Zonal Wind
m/s
90°N
60°N
30°N
0°
30°S
60°S
90°S
180° 150°W 120°W 90°W 60°W 30°W 0° 30°E 60°E 90°E 120°E 150°E 180°
−12 −8 −4 0 4 8 12 16 20 24 28 32 36 40

Utility Functions

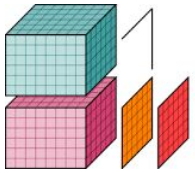
The Transition from NCL to Python

```
;================================================
;  lb_1.ncl
;================================================
;
; Concepts illustrated:
;   - Generating the default labelbar on a contour plot
;   - Setting color maps using the new standard
;
;================================================
;
; These files are loaded by default in NCL V6.2.0 and newer
; load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_code.ncl"
; load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_csm.ncl"
; load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/contributed.ncl"

;************************************************
begin
;************************************************
; open netCDF file and read in data
;************************************************
  in = addfile("atmos.nc","r")
  v  = in->V

;************************************************
; create plot
;************************************************
  wks = gsn_open_wks("png","lb")           ; send graphics to PNG file

  res                =   True
  res@cnFillOn       =   True              ; turn on color
  res@cnFillPalette  =   "wgne15"          ; set color map
  contour = gsn_csm_contour_map(wks,v(0,3,:,:),res)  ; create the plot
end
```

Original NCL Script

400%
Length Increase

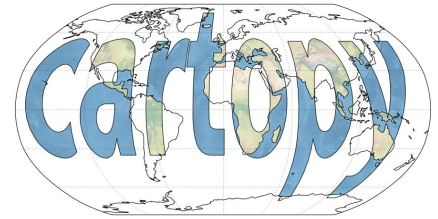
GeoCAT-Examples Script



xarray

NumPy

matplotlib



The Transition from NCL to Python

Parent Class
NCL Plot

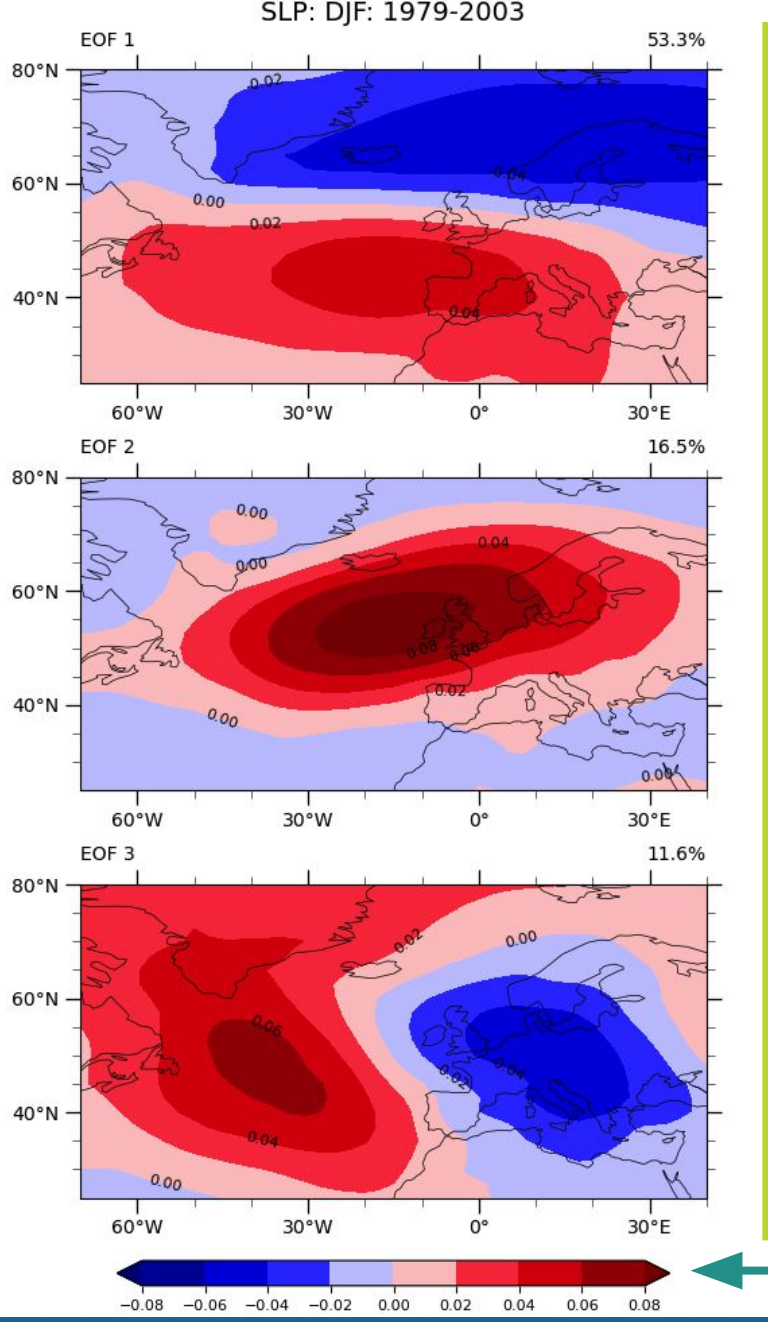
- Child Class
- Child Class
- Child Class *Contour*
- Child Class
- Child Class

NCL Plot

Parent Class

Functionalities

- Format plot
  - Create figure
  - Create and format axes
- Add colorbar
- Add geographical features
- Add titles and labels
- Show plot

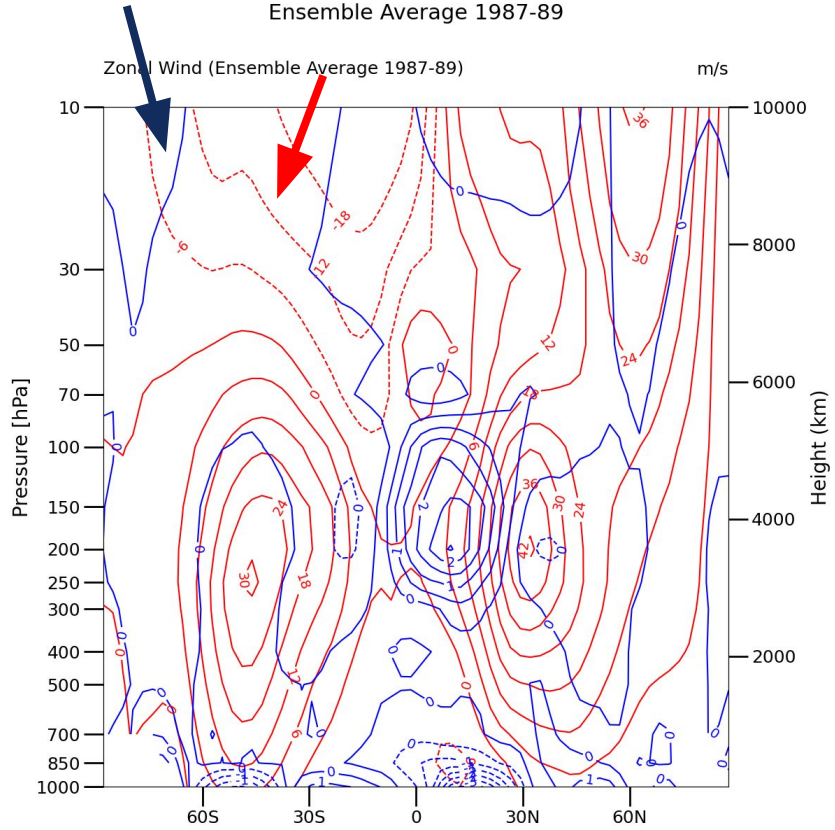


Added Features

- Subplot capabilities
- Overlaying plots

Updated Features

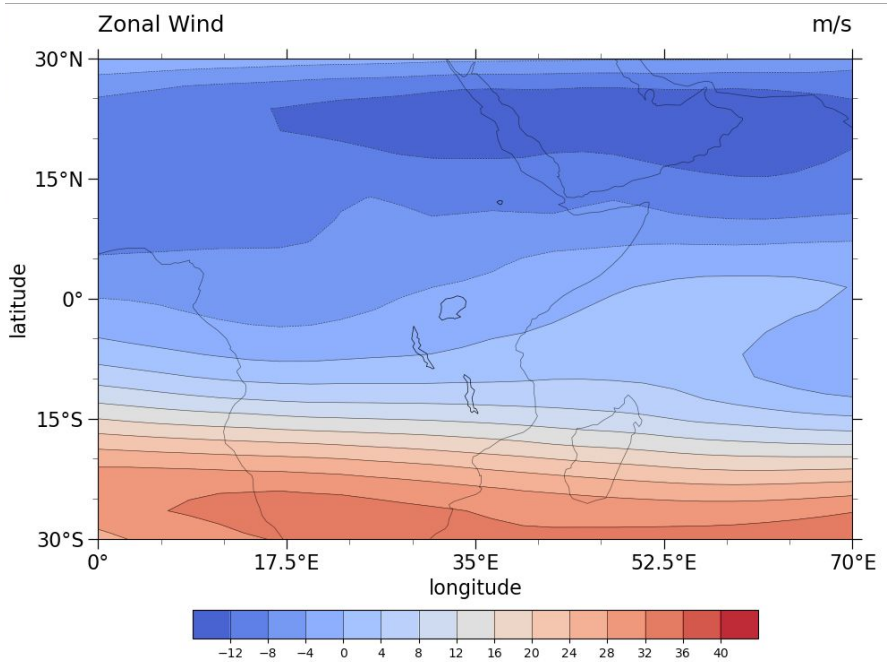
- Add colorbar arguments
- Infer colorbar placement
- Title and label inference

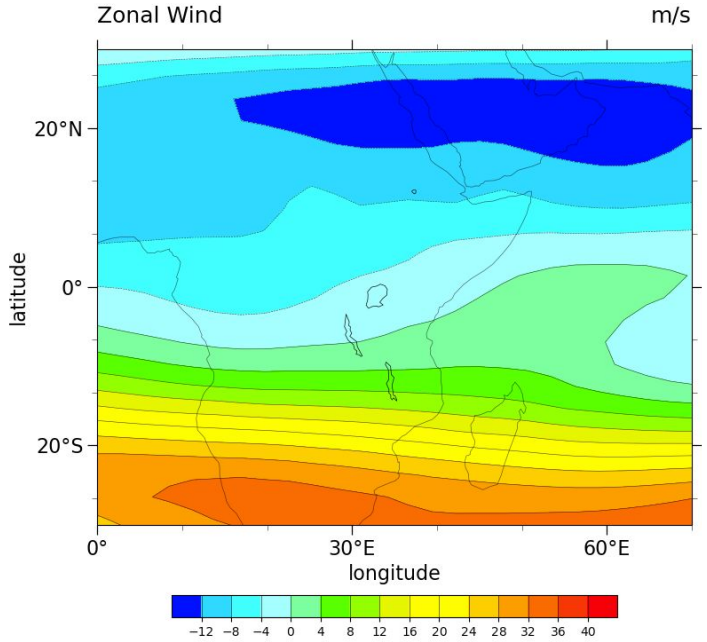


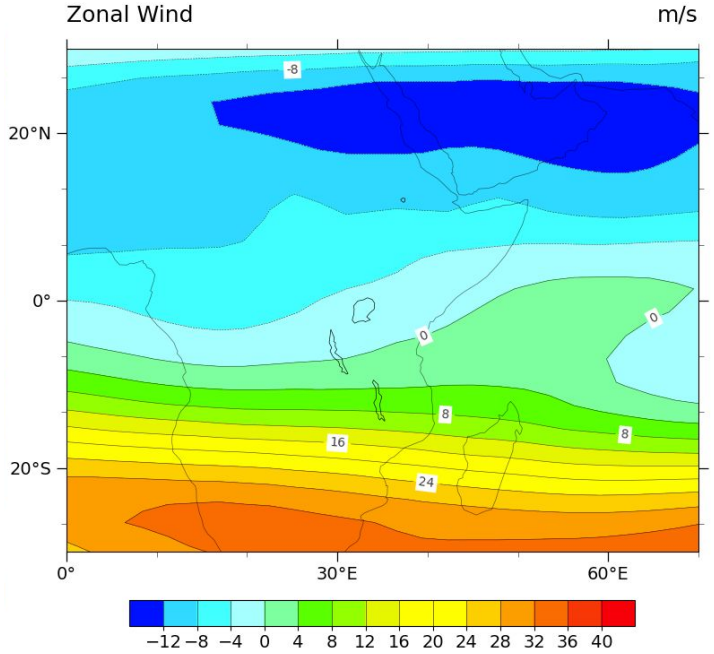
Contour
Child Class

Features

- Plot contours
  - Contour lines
  - Filled contours
- Add contour line labels







Complete Script	28	34	47
# of Contour Call Inputs	7	12	24

Original NCL
Complete Script: 35

GeoCAT-Examples Gallery
Complete Script: 108

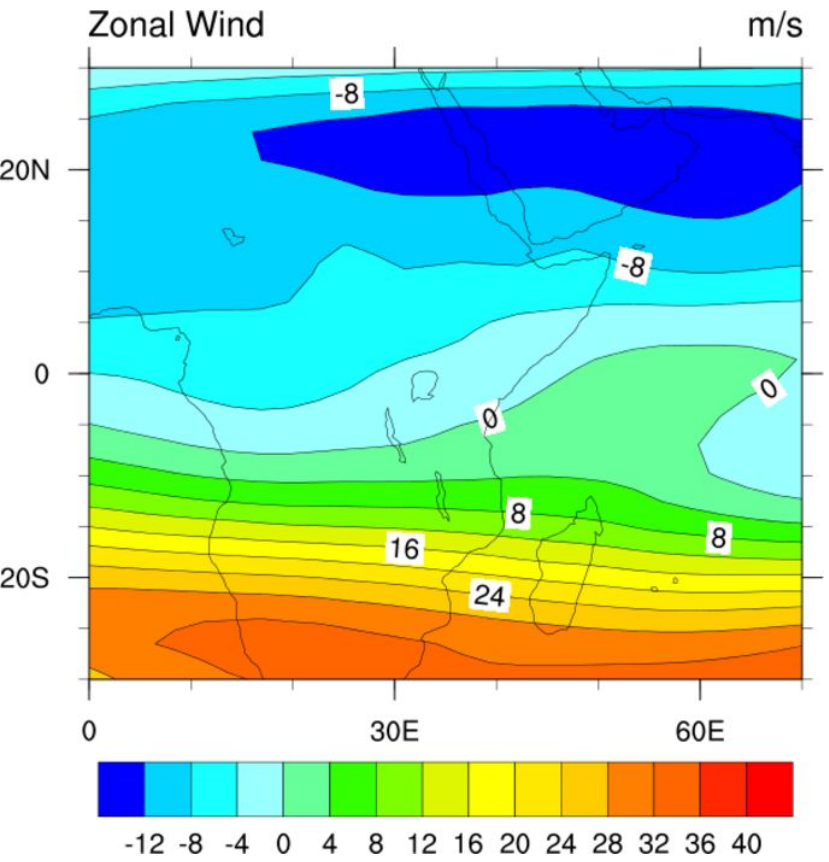
GeoCAT-Examples Script

```
"""
NCL_conLab_4.py
===============
This script illustrates the following concepts:
   - Drawing color-filled contours over a cylindrical equidistant map
   - Setting the background fill color for contour labels to white
   - Manually select where contour labels will be drawn
   - Changing the contour level spacing
   - Zooming in on a particular area on a cylindrical equidistant map
   - Creating left and right titles
   - Creating a horizontal colorbar

See following URLs to see the reproduced NCL plot & script:
    - Original NCL script: https://www.ncl.ucar.edu/Applications/Scripts/conLab_4
    - Original NCL plot: https://www.ncl.ucar.edu/Applications/Images/conLab_4_lg
"""

################################################################################
# Import packages:
import numpy as np
import xarray as xr
from cartopy.mpl.gridliner import LatitudeFormatter, LongitudeFormatter
import cartopy.crs as ccrs
import cartopy.feature as cfeature
import matplotlib.pyplot as plt

import geocat.datafiles as gdf
from geocat.viz import cmaps as gvcmaps
from geocat.viz import util as gvutil

################################################################################
# Read in data:

# Open a netCDF data file using xarray default engine and load the data into xar
ds = xr.open_dataset(gdf.get("netcdf_files/uv300.nc"), decode_times=False)
U = ds.isel(time=1, drop=True).U

# Reduce the dataset to something just bigger than the area we want to plot.
# This will improve how the contour lines are labeled
U = U.where(U.lon >= 0)
U = U.where(U.lon <= 71)
U = U.where(U.lat >= -33)
U = U.where(U.lat <= 33)

################################################################################
# Plot:
plt.figure(figsize=(8, 8))

# Create axes using the Plate Carree rectangular projection
ax = plt.axes(projection=ccrs.PlateCarree())

# Draw map features
ax.add_feature(cfeature.LAKES,
               linewidth=0.5,
               edgecolor='black',
               facecolor='None')
ax.add_feature(cfeature.COASTLINE, linewidth=0.5)

# Zoom in on region bounded by the prime meridian, 70N, 25S, and 25N
ax.set_extent([0, 70, -30, 30], crs=ccrs.PlateCarree())

# Use geocat.viz.util convenience function to set axes tick values
gvutil.set_axes_limits_and_ticks(ax,
                                 x_minor_per_major=3,
                                 y_minor_per_major=4,
                                 labelsize=14)

# Use geocat.viz.util convenience function to add titles to left and right of
# the plot axis
gvutil.set_titles_and_labels(ax, lefttitle=U.long_name, righttitle=U.units)

# Select a color map
cmap = gvcmaps.gui_default

# Draw filled contours
colors = U.plot.contourf(ax=ax,
                         cmap=cmap,
                         levels=np.arange(-16, 48, 4),
                         add_colorbar=False,
                         add_labels=False)

# Draw contour lines
lines = U.plot.contour(ax=ax,
                       colors='black',
                       levels=np.arange(-16, 48, 4),
                       linewidths=0.5,
                       linestyles='solid',
                       add_labels=False)

# Create horizontal colorbar
cbar = plt.colorbar(colors,
                    ticks=np.arange(-12, 44, 4),
                    orientation='horizontal',
                    drawedges=True,
                    aspect=12,
                    shrink=0.8,
                    pad=0.075)
cbar.ax.tick_params(labelsize=14)  # Make the labels larger

# Specify coordinates for contour labels in (longitude, latitude) format
manual = [(25, 28), (30, -17), (40, -21), (40, -5), (42, -13), (10, 50),
          (62, -15), (65, -2)]

# Draw contour labels and pass in coordinates using `manual` argument
ax.clabel(lines, fontsize=12, fmt='%d', inline=True, manual=manual)

# Set label backgrounds white
[
    txt.set_bbox(dict(facecolor='white', edgecolor='none', pad=2))
    for txt in lines.labelTexts
]
plt.show()
```

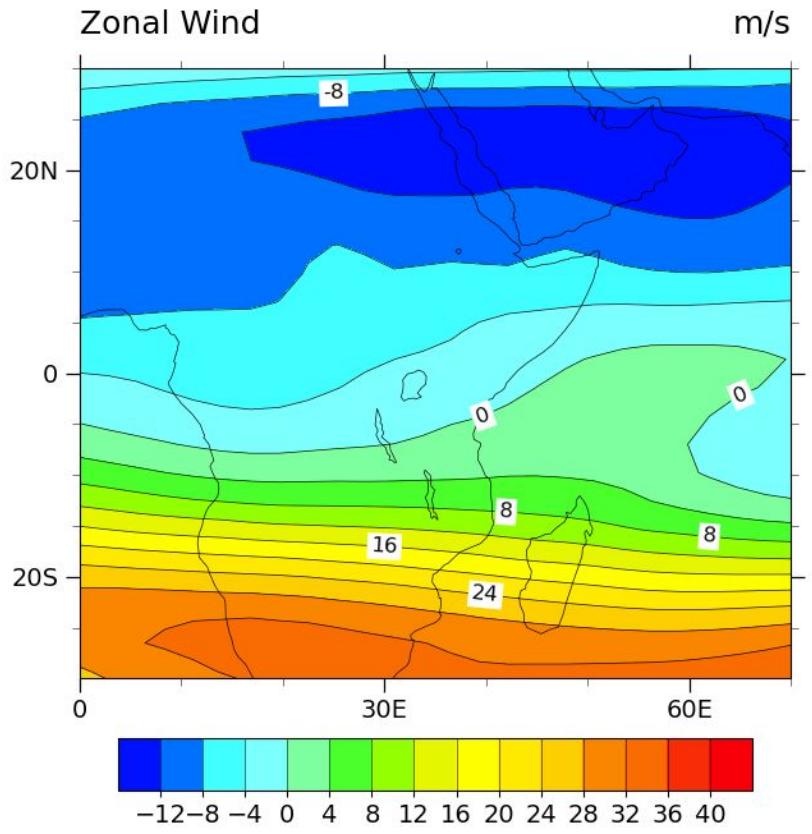
57%
Length Decrease

```
import xarray as xr
import numpy as np
import cartopy.crs as ccrs
import geocat.datafiles as gdf
from geocat.viz import cmaps as gvcmaps
from contourf import *

# Open a netCDF data file using xarray default engine and load the data into xarrays
ds = xr.open_dataset(gdf.get("netcdf_files/uv300.nc"), decode_times=False)
U = ds.isel(time=1, drop=True).U

# Reduce the dataset to something just bigger than the area we want to plot.
# This will improve how the contour lines are labeled
U = U.where(U.lon >= 0)
U = U.where(U.lon <= 71)
U = U.where(U.lat >= -33)
U = U.where(U.lat <= 33)

cplot = Contour(U,
                X = U.lon,
                Y = U.lat,
                h = 8,
                w = 8,
                flevels= np.arange(-16, 48, 4),
                clevels = np.arange(-16, 48, 4),
                xlim=(0,70),
                ylim=(-30,30),
                xticks=np.linspace(0, 60, 3),
                yticks=np.linspace(-20, 20, 3),
                ticklabelfontsize = 14,
                projection=ccrs.PlateCarree(),
                cmap=gvcmaps.gui_default,
                cbticks = np.arange(-12, 44, 4),
                cbpad = 0.075,
                cbshrink = 0.8,
                cbticklabelsize = 14,
                xlabel="",
                ylabel="",
                drawcontourlabels = True,
                contourlabels = [(25, 28), (30, -17), (40, -21), (40, -5), (42, -13), (10, 50),
                                 (62, -15), (65, -2)],
                manualcontourlabels = True,
                contourbackground=True
                )

cplot.show_lakes(scale="110m")
cplot.show()
```

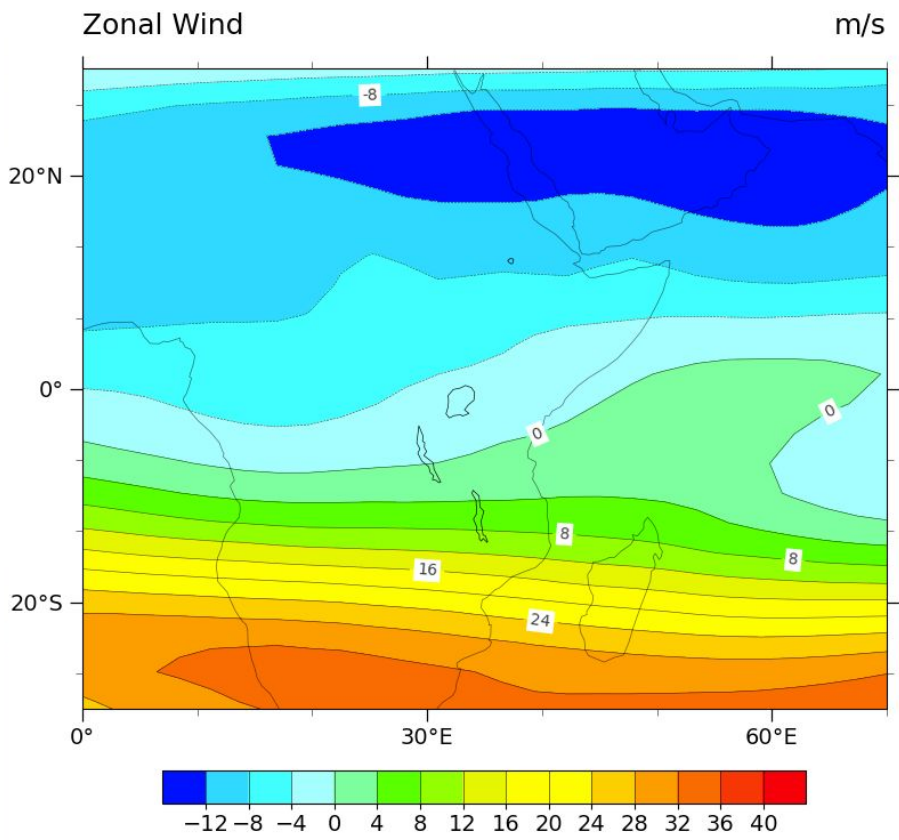
Contour Class Script



Original NCL Figure

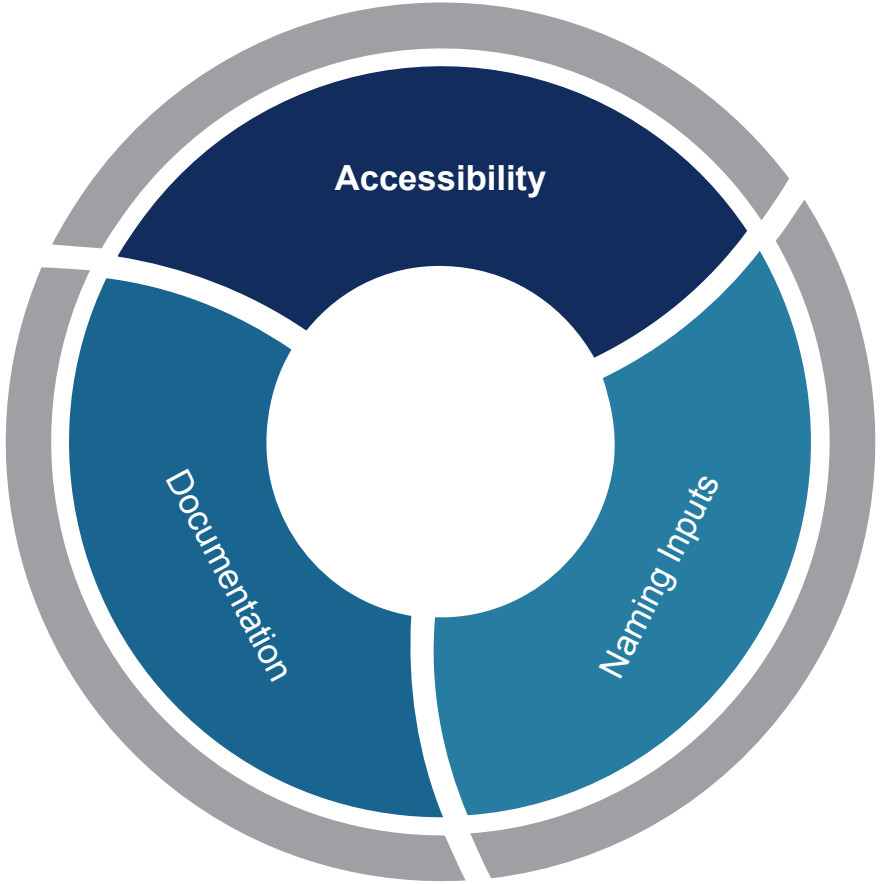


GeoCAT-Examples Gallery Figure



Contour Class Figure

Other Considerations



Questions?

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GeoCAT-Examples Gallery

GeoCAT-Examples GitHub

GeoCAT-Viz GitHub

Special thanks to Michaela Sizemore, Anissa Zacharias, Jiaqi Li, Heather Craker, Orhan Eroglu, Alea Kootz, Julia Kent, and SIParCS team!