02.a.GFS_subplots

October 29, 2022

1 Veremos como hacer subplots diversos

[ ]:
```
from siphon.catalog import TDSCatalog
import numpy as np
```

Como ya habiamos hecho el script inicial ahora vamos a trabajar con una funcion mas sencilla

[ ]:
```
def get_gfs_espacial(b_url, id_url=0, lonlat=None, nivel=100_000, tiempo=None,␣
↪variables=None):
    ''''
    b_url: url del catalogo
    id_url: posición del producto deseado
    lonlat: lista con la posicion de las esquina superior izquierda e inferior␣
↪derecha
            [lon_min, lat_max, lon_max, lat_min]
    tiempo: tiempo en hora UTC para la data requerida
    *variables: lista de variables objetivo
    '''
    # define el tiempo por defecto
    from datetime import datetime, timedelta, timezone
    t_in = datetime.now(timezone.utc)
    t_fin = datetime.now(timezone.utc)

    if lonlat is None:
        lonlat = [270, 5, 300, -25]
    if variables is None:
        variables = ['Temperature_isobaric']

    best = TDSCatalog(b_url)
    best_ds = best.datasets[id_url]
    ncss =best_ds.subset()
    query = ncss.query()
    if tiempo is None:
        query.lonlat_box(west=lonlat[0], north=lonlat[1], east=lonlat[2],␣
↪south=lonlat[3]).vertical_level(nivel).time_range(t_in, t_fin)
    else:
```

```
        query.lonlat_box(west=lonlat[0], north=lonlat[1], east=lonlat[2],␣
↪south=lonlat[3]).vertical_level(nivel).time_range(tiempo[0], tiempo[1])
    query.accept('netcdf4')
    query.variables(*variables)

    # haciendo el requerimiento de los datos
    data = ncss.get_data(query)
    from xarray.backends import NetCDF4DataStore
    import xarray as xr

    return xr.open_dataset(NetCDF4DataStore(data))
```

Ahora trabajemos con nuestra nueva función

[ ]:
```
from datetime import datetime, timedelta, timezone

url = 'http://thredds.ucar.edu/thredds/catalog/grib/NCEP/GFS/Global_0p25deg/
↪catalog.xml'
lon_lat = [270, 0, 300, -20]

t_incial = datetime.now(timezone.utc)
t_final = t_incial + timedelta(hours=3)
tiempo_obj = (t_incial, t_final)

variables_int = ['Temperature_isobaric',
                 'Relative_humidity_isobaric',
                 'u-component_of_wind_isobaric',
                 'v-component_of_wind_isobaric']

data_gfs  = get_gfs_espacial(b_url=url, lonlat=lon_lat, tiempo=tiempo_obj,␣
↪variables=variables_int)
data_gfs_prueba  = get_gfs_espacial(b_url=url, tiempo=tiempo_obj,␣
↪variables=variables_int)
```

[ ]:
```
data_gfs
```

[ ]:
```
<xarray.Dataset>
Dimensions:                        (validtime2: 2, reftime: 1, latitude: 81,
                                    isobaric: 1, longitude: 121)
Coordinates:
    validtime2Forecast             (validtime2) datetime64[ns] …
  * reftime                        (reftime) datetime64[ns] 2022-10-28T12:00:00
  * validtime2                     (validtime2) datetime64[ns] 2022-10-28T21:…
  * latitude                       (latitude) float32 0.0 -0.25 … -19.75 -20.0
  * isobaric                       (isobaric) float64 1e+05
  * longitude                      (longitude) float32 270.0 270.2 … 300.0
Data variables:
```

```
    Relative_humidity_isobaric     (reftime, validtime2, isobaric, latitude,
longitude) float32 …
    Temperature_isobaric           (reftime, validtime2, isobaric, latitude,
longitude) float32 …
    u-component_of_wind_isobaric   (reftime, validtime2, isobaric, latitude,
longitude) float32 …
    v-component_of_wind_isobaric   (reftime, validtime2, isobaric, latitude,
longitude) float32 …
    LatLon_721X1440-0p13S-180p00E  int32 …
Attributes: (12/13)
    Originating_or_generating_Center:                                      …
    Originating_or_generating_Subcenter:                                   …
    GRIB_table_version:                                                    …
    Type_of_generating_process:                                            …
    Analysis_or_forecast_generating_process_identifier_defined_by_originating…
    Conventions:                                                           …
    …
…
    featureType:                                                           …
    History:                                                               …
    geospatial_lat_min:                                                    …
    geospatial_lat_max:                                                    …
    geospatial_lon_min:                                                    …
    geospatial_lon_max:                                                    …
```

[ ]:
```
data_gfs_prueba
```

[ ]:
```
<xarray.Dataset>
Dimensions:                        (validtime2: 2, reftime: 1, latitude: 121,
                                    isobaric: 1, longitude: 121)
Coordinates:
    validtime2Forecast             (validtime2) datetime64[ns] …
  * reftime                        (reftime) datetime64[ns] 2022-10-28T12:00:00
  * validtime2                     (validtime2) datetime64[ns] 2022-10-28T21:…
  * latitude                       (latitude) float32 5.0 4.75 … -24.75 -25.0
  * isobaric                       (isobaric) float64 1e+05
  * longitude                      (longitude) float32 270.0 270.2 … 300.0
Data variables:
    Relative_humidity_isobaric     (reftime, validtime2, isobaric, latitude,
longitude) float32 …
    Temperature_isobaric           (reftime, validtime2, isobaric, latitude,
longitude) float32 …
    u-component_of_wind_isobaric   (reftime, validtime2, isobaric, latitude,
longitude) float32 …
    v-component_of_wind_isobaric   (reftime, validtime2, isobaric, latitude,
longitude) float32 …
    LatLon_721X1440-0p13S-180p00E  int32 …
```

```
Attributes: (12/13)
    Originating_or_generating_Center:                                    …
    Originating_or_generating_Subcenter:                                 …
    GRIB_table_version:                                                  …
    Type_of_generating_process:                                          …
    Analysis_or_forecast_generating_process_identifier_defined_by_originating…
    Conventions:                                                         …
    …
…
    featureType:                                                         …
    History:                                                             …
    geospatial_lat_min:                                                  …
    geospatial_lat_max:                                                  …
    geospatial_lon_min:                                                  …
    geospatial_lon_max:                                                  …
```

[ ]:
```
# vamos a trabajar la longitud con -360, el modelo retorno de 0 a 360
lon = data_gfs.longitude.data - 360
lat = data_gfs.latitude.data
T = data_gfs.Temperature_isobaric.data[0,:,0] # temperatura en kelvin
U = data_gfs['u-component_of_wind_isobaric'].data[0,:,0]  # velocida en m/s
V = data_gfs['v-component_of_wind_isobaric'].data[0,:,0] # velocida en m/s

# generando los puntos para graficar
lon, lat = np.meshgrid(lon, lat)
```

[ ]:
```
data_gfs.Temperature_isobaric.shape
```

[ ]:
```
(1, 2, 1, 81, 121)
```

[ ]:
```
a = list(range(10))
a
```

[ ]:
```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

[ ]:
```
a[::2]
```

[ ]:
```
[0, 2, 4, 6, 8]
```

1.1 Plot y subplot

Ahora vemos que podemos hacer para los gráficos

[ ]:
```
from matplotlib import pyplot as plt

from cartopy import feature as cf
import cartopy.crs as ccrs
```

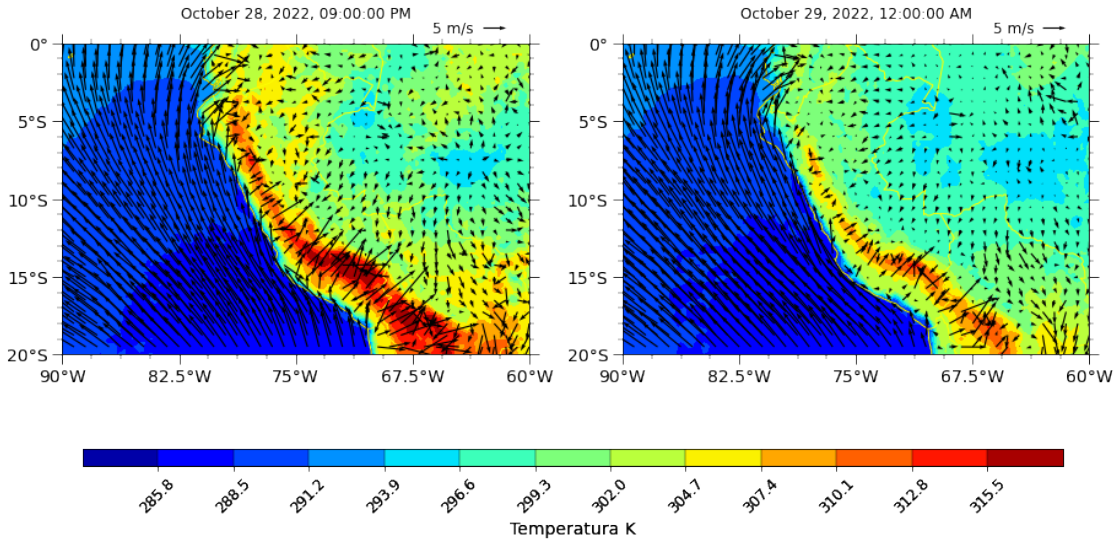
```
from cartopy.io.shapereader import Reader as ShapeReader, natural_earth

import cmaps
import geocat.viz as gv
```

[ ]:
```
def make_plot_conf(lon, lat, T, fig, subp, projection=None, bar_title=None):
    if projection is None:
        projection = ccrs.PlateCarree()
    if bar_title is None:
        bar_title = 'Temperatura ($^{o}$C)'
    # niveles de temperatura
    clevs = np.linspace(283.15, 318.15, 14)

    # en mi caso retorna un problema de existencia de la paleta de colores
    try:
        cmap = cmaps.MPL_jet

        # Importando la base del colormap para trabajar
        newcmp = gv.truncate_colormap(cmap,
                                      minval=0.1,
                                      maxval=0.6,
                                      n=len(clevs))
    except ValueError:
        newcmp = plt.cm.jet

    # definiendo las dimensiones y proyección de la nueva figura
    ax= fig.add_subplot(subp[0], subp[1], subp[2], projection=projection)

    ax.set_extent([lon.min(), lon.max(), lat.min(), lat.max()], crs=projection)
    ax.coastlines('50m', linewidth=0.8)
    ax.add_feature(cf.BORDERS, edgecolor="yellow")
    ax.add_feature(cf.COASTLINE, edgecolor="yellow")

    # gráfico de contorno relleno de la temperatura
    c_f = ax.contourf(lon, lat, T, levels=clevs, cmap=newcmp, zorder=1)

    # colocando la barra de colores en modo horizontal
    cax = plt.axes((0.14, 0.2, 0.74, 0.02))
    cbar = plt.colorbar(c_f, ax=ax, cax=cax, ticks=clevs[1:-1], drawedges=True,
                        orientation='horizontal', format='%.1f')
    cbar.ax.tick_params(labelsize=12, rotation=45)
    cbar.set_label(bar_title, size=14)

    # definimos las caracteristicas de los "ticks"
    gv.set_axes_limits_and_ticks(ax,
                                 xticks=np.linspace(lon.min(), lon.max(), 5),
                                 yticks=np.linspace(lat.min(), lat.max(), 5))
```

```
    # Adicion de las latitudes y longitudes correspondientes
    gv.add_lat_lon_ticklabels(ax)

    # configuración de los "ticks" mayores y menores
    gv.add_major_minor_ticks(ax,
                             x_minor_per_major=4,
                             y_minor_per_major=5,
                             labelsize=14)
    return ax
```

[ ]:
```
bar_title = 'Temperatura K'

fig = plt.figure(figsize=(15, 10))

### plot 1
subp = [1, 2, 1]
ax_1 = make_plot_conf(fig=fig, subp=subp, lon=lon, lat=lat, T=T[0],␣
 ↪bar_title=bar_title)
# Definiendo las características de las flechas
Q = ax_1.quiver(lon[::3,::3], lat[::3,::3], U[0,::3,::3], V[0,::3,::3],
                color='black', width=.003, scale=100., headwidth=3.,
                zorder=4)

ax_1.quiverkey(Q, 0.9, 1.05, 5, '5 m/s', labelpos='W', color='black',
               coordinates='axes', fontproperties={'size': 12},
               labelsep=0.1)

# tener cuidado con la variable de tiempo, no siempre se guarda en la misma␣
 ↪variable
# puede ser reftime, validtime2....
ax_1.set_title(f"{data_gfs.validtime2[0].dt.strftime('%B %d, %Y, %r').data}",␣
 ↪pad=20)

### plot 2
subp = [1, 2, 2]
ax_2 = make_plot_conf(lon=lon, lat=lat, fig=fig, subp=subp, T=T[1],␣
 ↪bar_title=bar_title)
# Definiendo las características de las flechas
Q = ax_2.quiver(lon[::3,::3], lat[::3,::3], U[1,::3,::3], V[1,::3,::3],
                color='black', width=.003, scale=100., headwidth=3.,
                zorder=4)

ax_2.quiverkey(Q, 0.9, 1.05, 5, '5 m/s', labelpos='W', color='black',
               coordinates='axes', fontproperties={'size': 12},
               labelsep=0.1)
```

```
ax_2.set_title(f"{data_gfs.validtime2[1].dt.strftime('%B %d, %Y, %r').data}",␣
↪pad=20)
# mostrar el gráfico final
plt.show()
```



[ ]:
```
data_gfs.validtime2[0].dt.strftime('%B %d, %Y, %r').data
```

[ ]:
```
array('October 28, 2022, 09:00:00 PM', dtype=object)
```

1.2 Retornar al indice