

APPENDIX

IMPORTING LIBRARIES

```
import xarray as xr
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import cartopy.crs as ccrs
import cartopy.feature as cfeature
```

EXTRACTING FILE

```
Mauritania_data =
xr.open_mfdataset('/home/lady-josephine/Documents/mauritania/*.nc')
Mauritania_data
```

SLICING DATETIME AND COORDINATES

```
Mauritania =
Mauritania_data.sel(datetime=slice("2001","2010"),lon=(-16.75),lat=(27.25))
Mauritania
```

SELECTING VARIABLE NAME PRECIP

```
Mauritania_precip = Mauritania.precip
Mauritania_precip
```

```
Monthly_rainfall_totals = Mauritania_precip.resample(datetime='1M').sum('datetime')
Monthly_rainfall_totals
```

```
longterm_climatology = Monthly_rainfall_totals.groupby('datetime.month').mean()
longterm_climatology
```

QUESTION 2

```
Annual_totals = Mauritania_precip.resample(datetime='1Y').sum()
Annual_totals
Mauritania_Average = Annual_totals.groupby('datetime.month').mean()
Mauritania_Average
fig, ax = plt.subplots(figsize = (12,6))
plt.subplots_adjust(hspace = 0.5, wspace = 0.2)
Annual_totals.plot(color = 'purple', lw = 1.5, marker = '*', markersize =
'6',label='Precipitation')
ax.set_title(' Timeseries For Annual Precipitation Over Mauritania(2001-2010)',fontsize
= 15,color='purple')
ax.set_xlabel('Year',fontsize = 15,color = 'purple')
ax.set_ylabel('Precip',fontsize = 15,color = 'purple')
plt.legend()
```

```
plt.show()
```

QUESTION 3M =

```
xr.open_mfdataset('/home/lady-josephine/Documents/mauritania/*.nc')MMauritania_2 =
M.sel(datetime=slice("2001","2010"),lon=(-16.75),lat=(27.25))Mauritania_2Mauritania_precip2 =
M['precip']Mauritania_precip2Dry = Mauritania_precip2Dry_days_per_year = (Dry <
1).groupby('datetime.year').sum(dim='datetime')Dry_days_per_yearfig,ax=plt.subplots(5,2,figsiz
e=(20,18),subplot_kw={'projection':
ccrs.PlateCarree()})ax=ax.flatten()month_names=['2001','2002','2003','2004','2005','2006','2007',
'2008','2009','2010']for i in range(10):
ax[i].add_feature(cfeature.COASTLINE.with_scale('110m'),linewidth=0.5)
ax[i].add_feature(cfeature.BORDERS,linewidth=2) ax[i].add_feature(cfeature.OCEAN)
ax[i].add_feature(cfeature.LAKES, color='blue') ax[i].add_feature(cfeature.RIVERS)
ax[i].set_extent([-16.75, -5.25, 15.75,27.25], crs=ccrs.PlateCarree())
ax[i].set_title(month_names[i])cb=
ax[i].contourf(Dry_days_per_year.lon,Dry_days_per_year.lat,Dry_days_per_year[i],
cmap='coolwarm', transform=ccrs.PlateCarree())
color_bar=fig.add_axes([0.82,0.29,0.025,0.5])fig.colorbar(cb,cax=color_bar,label='Precipitation(
mm)')fig.subplots_adjust(wspace=-0.55, top=0.93)
plt.suptitle(' DRY DAYS PER YEAR OVER MAURITANIA(>=1MM)', fontweight='bold');
```

Dry_days_per_month=

```
(Dry<1).groupby('datetime.month').sum(dim='datetime')Dry_days_per_monthfig,ax=plt.subplots(
3,4,figsize=(16,8),subplot_kw={'projection': ccrs.PlateCarree()})ax=ax.flatten()month_names =
['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'July', 'Aug', 'Sept','Oct','Nov','Dec']for i in range(12):
ax[i].add_feature(cfeature.COASTLINE.with_scale('110m'),linewidth=0.5)
ax[i].add_feature(cfeature.BORDERS,linewidth=2) ax[i].add_feature(cfeature.OCEAN)
ax[i].add_feature(cfeature.LAKES, color='blue') ax[i].add_feature(cfeature.RIVERS)
ax[i].set_extent([-16.75, -5.25, 15.75,27.25], crs=ccrs.PlateCarree())
ax[i].set_title(month_names[i]) cb=
ax[i].contourf(Dry_days_per_month.lon,Dry_days_per_month.lat,Dry_days_per_month[i],
cmap='coolwarm', transform=ccrs.PlateCarree())
color_bar=fig.add_axes([0.82,0.29,0.025,0.5])fig.colorbar(cb,cax=color_bar,label='Precipitation(
mm)')fig.subplots_adjust(wspace=-0.55, top=0.93)plt.suptitle(' DRY DAYS PER MONTH OVER
MAURITANIA(<1MM)', fontweight='bold');
```

Dry_days_per_year_time=(Mauritania_precip<

```
1).resample(datetime='1Y').sum()Dry_days_per_year_timefig, ax = plt.subplots(figsize =
(10,3))plt.subplots_adjust(hspace = 0.5, wspace = 0.2)Dry_days_per_year_time.plot(color =
'purple', lw = 1.5, marker = 'o', markersize = '6',label='dry days')ax.set_title('Dry Days Per Year
Timeseries Over Mauritania (2001-2010)<1mm',fontsize =
15,color='Purple')ax.set_xlabel('Year',fontsize = 15,color='purple')ax.set_ylabel('Precip',fontsize
= 15,color='purple')plt.legend()plt.show()Dry_days_per_month_time=(Mauritania_precip<
```

```

1).resample(datetime='1M').sum()Dry_days_per_month_timefig, ax = plt.subplots(figsize =
(10,3))plt.subplots_adjust(hspace = 0.5, wspace = 0.2)Dry_days_per_month_time.plot(color =
'green', lw = 1.5, marker = 'o', markersize = '6',label='dry days')ax.set_title('Dry Days Per Month
Timeseries Over Mauritania (2001-2010)<1mm',fontsize =
15,color='green')ax.set_xlabel('YEAR',fontsize =
15,color='green')ax.set_ylabel('PRECIP',fontsize = 15,color='green')plt.legend()plt.show()

```

```

Wet = Mauritania_precip2Wet_days_per_year = (Wet >=
1).groupby('datetime.year').sum(dim='datetime')Wet_days_per_yearfig,ax=plt.subplots(5,2,figsiz
e=(20,18),subplot_kw={'projection':
ccrs.PlateCarree()})ax=ax.flatten()month_names=['2001','2002','2003','2004','2005','2006','2007',
'2008','2009','2010']for i in range(10):
ax[i].add_feature(cfeature.COASTLINE.with_scale('110m'),linewidth=0.5)
ax[i].add_feature(cfeature.BORDERS,linewidth=2) ax[i].add_feature(cfeature.OCEAN)
ax[i].add_feature(cfeature.LAKES, color='blue') ax[i].add_feature(cfeature.RIVERS)
ax[i].set_extent([-16.75, -5.25, 15.75,27.25], crs=ccrs.PlateCarree())
ax[i].set_title(month_names[i]) cb=
ax[i].contourf(Wet_days_per_year.lon,Wet_days_per_year.lat,Wet_days_per_year[i],
cmap='coolwarm', transform=ccrs.PlateCarree())
color_bar=fig.add_axes([0.82,0.29,0.025,0.5])fig.colorbar(cb,cax=color_bar,label='Precipitation(
mm)')fig.subplots_adjust(wspace=-0.55, top=0.93)plt.suptitle(' WET DAYS PER YEAR OVER
MAURITANIA(>=1MM)', fontweight='bold');

```

```

Wet_days_per_month=(Mauritania_precip<
1).resample(datetime='1M').sum()Wet_days_per_monthfig,ax=plt.subplots(3,4,figsize=(16,8),su
bplot_kw={'projection': ccrs.PlateCarree()})ax=ax.flatten()month_names = ['Jan', 'Feb', 'Mar',
'Apr', 'May', 'Jun', 'July', 'Aug', 'Sept','Oct','Nov','Dec']for i in range(12):
ax[i].add_feature(cfeature.COASTLINE.with_scale('110m'),linewidth=0.5)
ax[i].add_feature(cfeature.BORDERS,linewidth=2) ax[i].add_feature(cfeature.OCEAN)
ax[i].add_feature(cfeature.LAKES, color='blue') ax[i].add_feature(cfeature.RIVERS)
ax[i].set_extent([-16.75, -5.25, 15.75,27.25], crs=ccrs.PlateCarree())
ax[i].set_title(month_names[i]) cb=
ax[i].contourf(Wet_days_per_month.lon,Wet_days_per_month.lat,Wet_days_per_month[i],
cmap='coolwarm', transform=ccrs.PlateCarree())
color_bar=fig.add_axes([0.82,0.29,0.025,0.5])fig.colorbar(cb,cax=color_bar,label='Precipitation(
mm)')fig.subplots_adjust(wspace=-0.55, top=0.93)plt.suptitle('WET DAYS PER MONTH OVER
MAURITANIA(>1MM)', fontweight='bold');

```

```

Wet_days_per_year_time=(Mauritania_precip>=1).resample(datetime='1Y').sum()Wet_days_pe
r_year_timefig, ax = plt.subplots(figsize = (10,3))plt.subplots_adjust(hspace = 0.5, wspace =
0.2)Wet_days_per_year_time.plot(color = 'purple', lw = 1.5, marker = 'o', markersize =
'6',label='wet days')ax.set_title('Wet Days Per Year Timeseries Over
Mauritania(2001-2010)>=1mm',fontsize = 15,color='purple')ax.set_xlabel('Year',fontsize =
15,color='purple')ax.set_ylabel('Precip',fontsize = 15,color='purple')plt.legend()plt.show()

```

```

Wet_days_per_month_time=(Mauritania_precip>=1).resample(datetime='1M').sum()Wet_days_
per_month_timefig, ax = plt.subplots(figsize = (10,3))plt.subplots_adjust(hspace = 0.5, wspace =
0.2)Wet_days_per_month_time.plot(color = 'green', lw = 1.5, marker = 'o', markersize =
'6',label='wet days')ax.set_title('Wet Days Per Month Timeseries Over Mauritania
(2001-2010)>=1mm',fontweight = 'bold', fontsize = 15,color='green')ax.set_xlabel('YEAR',
fontweight = 'bold', fontsize = 15,color='green')ax.set_ylabel('PRECIP', fontweight = 'bold',
fontsize = 15,color='green')plt.legend()plt.show()

```

```

Wet_days_extreme_per_year=
(Wet>10).groupby('datetime.year').sum(dim='datetime')Wet_days_extreme_per_yearfig,ax=plt.s
ubplots(5,2,figsize=(20,18),subplot_kw={'projection':
ccrs.PlateCarree()})ax=ax.flatten()month_names=['2001','2002','2003','2004','2005','2006','2007',
'2008','2009','2010']for i in range(10):
ax[i].add_feature(cfeature.COASTLINE.with_scale('110m'),linewidth=0.5)
ax[i].add_feature(cfeature.BORDERS,linewidth=2) ax[i].add_feature(cfeature.OCEAN)
ax[i].add_feature(cfeature.LAKES, color='blue') ax[i].add_feature(cfeature.RIVERS)
ax[i].set_extent([-16.75, -5.25, 15.75,27.25], crs=ccrs.PlateCarree())
ax[i].set_title(month_names[i]) cb=
ax[i].contourf(Wet_days_extreme_per_year.lon,Wet_days_extreme_per_year.lat,Wet_days_extre
me_per_year[i], cmap='coolwarm', transform=ccrs.PlateCarree())
color_bar=fig.add_axes([0.82,0.29,0.025,0.5])fig.colorbar(cb,cax=color_bar,label='Precipitation(
mm)')fig.subplots_adjust(wspace=-0.55, top=0.93)plt.suptitle(' WET DAYS PER YEAR OVER
MAURITANIA(>10MM)', fontweight='bold');

```

```

Wet_days_extreme_per_year_time=(Mauritania_precip>10).resample(datetime='1Y').sum()Wet
_days_extreme_per_year_timefig, ax = plt.subplots(figsize = (10,3))plt.subplots_adjust(hspace
= 0.5, wspace = 0.2)Wet_days_extreme_per_year_time.plot(color = 'purple', lw = 1.5, marker =
'o', markersize = '6',label='wet days')ax.set_title('Wet Days Per Year Timeseries Over
Mauritania(2001-2010) > 10mm',fontsize = 15,color='purple')ax.set_xlabel('YEAR', fontsize =
15,color='purple')ax.set_ylabel('PRECIP',fontsize = 15,color='purple')plt.legend()plt.show()

```

```

Wet_days_extreme_per_year2 =
(Wet>20).groupby('datetime.year').sum(dim='datetime')Wet_days_extreme_per_year2fig,ax=plt.
subplots(5,2,figsize=(20,18),subplot_kw={'projection':
ccrs.PlateCarree()})ax=ax.flatten()month_names=['2001','2002','2003','2004','2005','2006','2007',
'2008','2009','2010']for i in range(10):
ax[i].add_feature(cfeature.COASTLINE.with_scale('110m'),linewidth=0.5)
ax[i].add_feature(cfeature.BORDERS,linewidth=2) ax[i].add_feature(cfeature.OCEAN)
ax[i].add_feature(cfeature.LAKES, color='blue') ax[i].add_feature(cfeature.RIVERS)
ax[i].set_extent([-16.75, -5.25, 15.75,27.25], crs=ccrs.PlateCarree())
ax[i].set_title(month_names[i]) cb=
ax[i].contourf(Wet_days_extreme_per_year2.lon,Wet_days_extreme_per_year2.lat,Wet_days_e
xtreme_per_year2[i], cmap='coolwarm', transform=ccrs.PlateCarree())

```

```
color_bar=fig.add_axes([0.82,0.29,0.025,0.5])fig.colorbar(cb,cax=color_bar,label='Precipitation(
mm)')fig.subplots_adjust(wspace=-0.55, top=0.93)plt.suptitle('WET DAYS PER YEAR OVER
MAURITANIA (>20MM)', fontweight='bold');
```

```
Wet_days_extreme_per_month2=(Wet>20).groupby('datetime.month').sum(dim='datetime')Wet
_days_extreme_per_month2fig,ax=plt.subplots(3,4,figsize=(16,8),subplot_kw={'projection':
ccrs.PlateCarree()})ax=ax.flatten()month_names = ['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'July',
'Aug', 'Sept','Oct','Nov','Dec']for i in range(12):
ax[i].add_feature(cfeature.COASTLINE.with_scale('110m'),linewidth=0.5)
ax[i].add_feature(cfeature.BORDERS,linewidth=2) ax[i].add_feature(cfeature.OCEAN)
ax[i].add_feature(cfeature.LAKES, color='blue') ax[i].add_feature(cfeature.RIVERS)
ax[i].set_extent([-16.75, -5.25, 15.75,27.25], crs=ccrs.PlateCarree())
ax[i].set_title(month_names[i]) cb=
ax[i].contourf(Wet_days_extreme_per_month2.lon,Wet_days_extreme_per_month2.lat,Wet_day
s_extreme_per_month2[i], cmap='coolwarm', transform=ccrs.PlateCarree())
color_bar=fig.add_axes([0.82,0.29,0.025,0.5])fig.colorbar(cb,cax=color_bar,label='Precipitation(
mm)')fig.subplots_adjust(wspace=-0.55, top=0.93)plt.suptitle('WET DAYS PER MONTH OVER
MAURITANIA(>20MM)', fontweight='bold');
```

```
Wet_days_extreme_per_year_time2=(Mauritania_precip>20).resample(datetime='1Y').sum()We
t_days_extreme_per_year_time2fig, ax = plt.subplots(figsize =
(10,3))plt.subplots_adjust(hspace = 0.5, wspace =
0.2)Wet_days_extreme_per_year_time2.plot(color = 'purple', lw = 1.5, marker = 'o', markersize
= '6',label='wet days')ax.set_title('Wet Days Per Year Timeseries Over
Mauritania(2001-2010)>20mm',fontsize = 15,color='purple')ax.set_xlabel('YEAR',fontsize =
15,color='purple')ax.set_ylabel('PRECIP',fontsize = 15,color='purple')plt.legend()plt.show()
```

```
Wet_days_extreme_per_month_time2=(Mauritania_precip>20).resample(datetime='1M').sum()
Wet_days_extreme_per_month_time2fig, ax = plt.subplots(figsize =
(10,3))plt.subplots_adjust(hspace = 0.5, wspace =
0.2)Wet_days_extreme_per_month_time2.plot(color = 'green', lw = 1.5, marker = 'o', markersize
= '6',label='wet days')ax.set_title('Wet Days Per Month Timeseries Over
Mauritania(2001-2010)>20mm',fontsize = 15,color='green')ax.set_xlabel('YEAR',fontsize =
15,color='green')ax.set_ylabel('PRECIP', fontsize = 15,color='green')plt.legend()plt.show()
```