HW3

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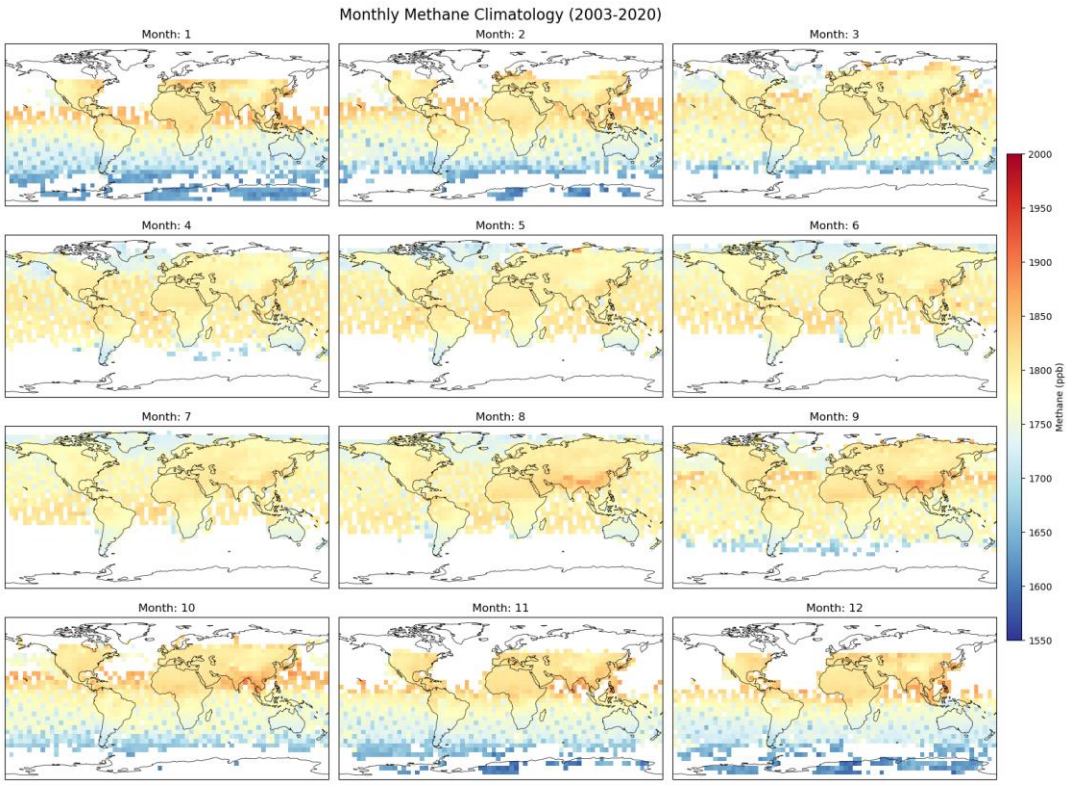
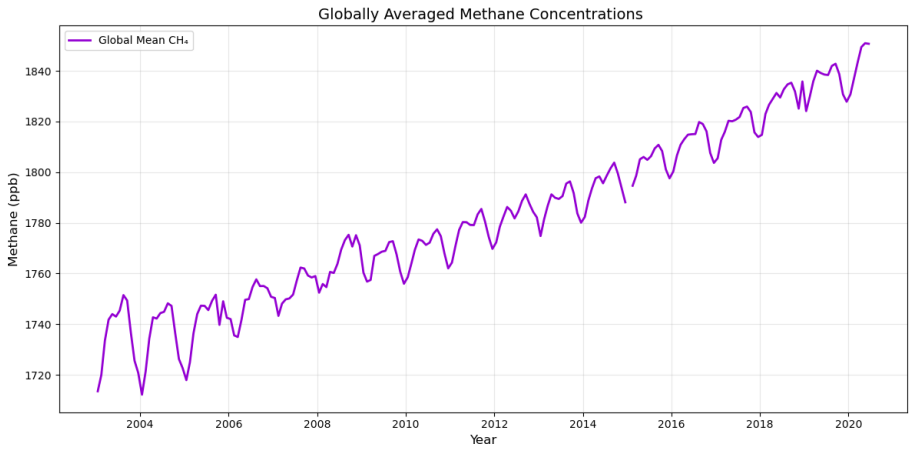
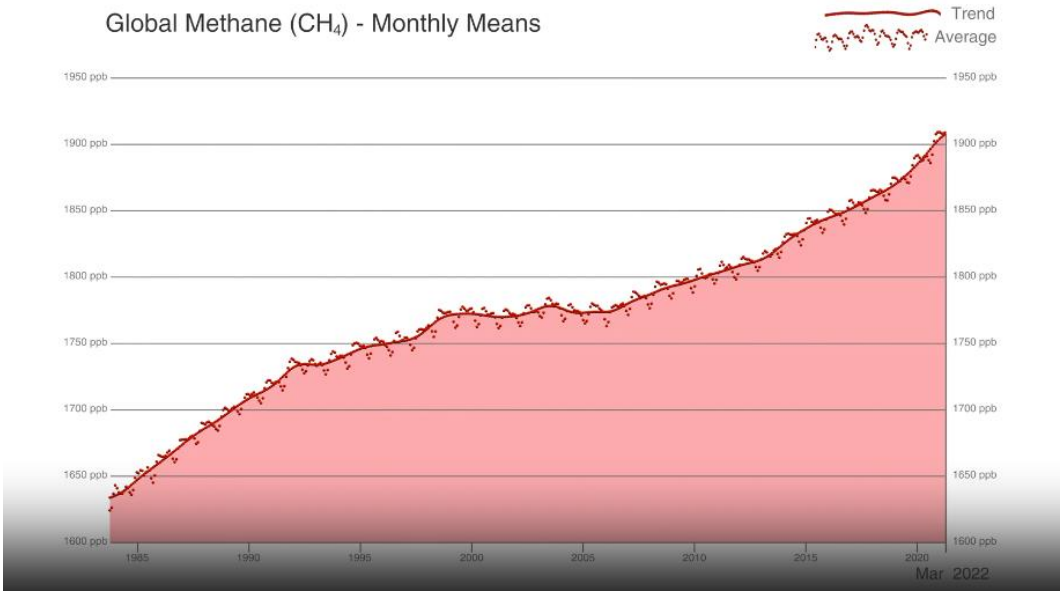
1. Global methane levels from 2002

1.1 [5 points] Compute methane climatology for each month, and plot your results in 12 panels.



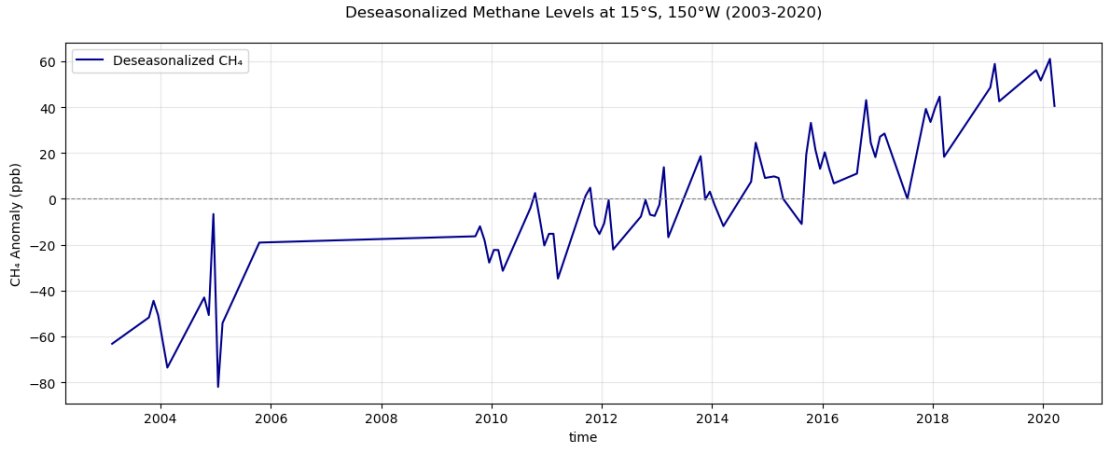
1.2 [5 points] Plot globally-averaged methane from 2003-01 to 2020-06 as a time series. Describe your results. Check your plot with this one.





甲烷浓度从 2003 年到 2020 年呈现持续上升的趋势，总增长量：137.18 ppb,在整体上升过程中，存在年度或季节性波动。与所给图像增长趋势大致相同。

1.3 [5 points] Plot deseasonalized methane levels at point [15° S,150° W] from 2003-01 to 2020-06 as a time series. Describe your results.



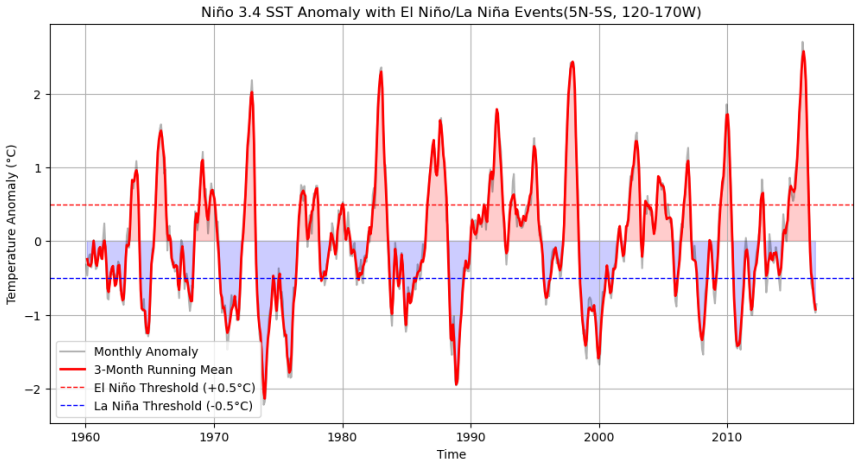
2003-2020 年间甲烷异常值持续攀升，由负值区域（低于季节均值）逐步转为正值（高于季节均值），后期增长斜率明显增大.早期（2003-2010）年际波动幅度较大且不规则，中后期（2010-2020）波动频率与幅度同步增强。

2. Niño 3.4 index

2.1 [10 points] Compute monthly climatology for SST from Niño 3.4 region, and subtract climatology from SST time series to obtain anomalies.

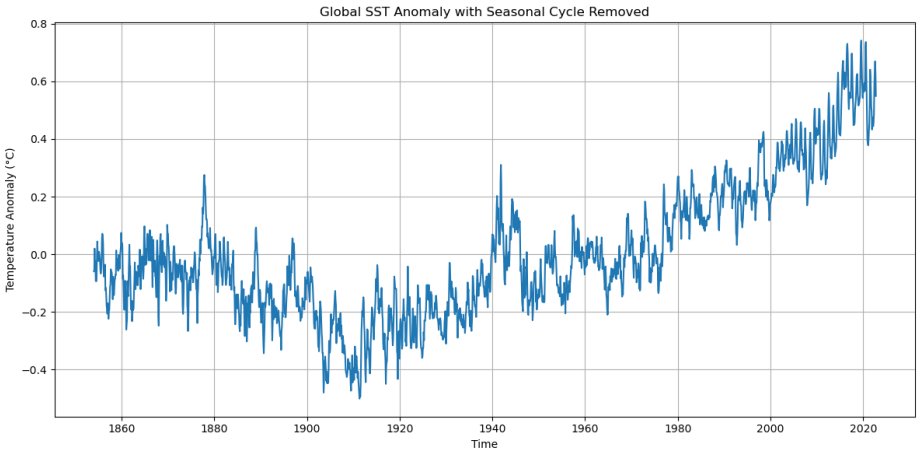
```python
#提取文件
ds = xr.open_dataset("NOAA_NCDC_ERSST_v3b_SST.nc", engine="netcdf4")
#提取nino3.4区域
nino34_=ds['sst'].sel(lat=slice(-5,5),lon=slice(190,240))

#加权面积法
lat_weights = np.cos(np.deg2rad(nino34_.lat))
nino34_sst = nino34_.weighted(lat_weights).mean(dim=('lon', 'lat'))

#2.1 Compute monthly climatology for SST from Niño 3.4 region, and subtract climatology from SST time series to obtain anomalies.
# 计算月度气候态
climatology = nino34_sst.groupby('time.month').mean()

#计算3个月滑动平均
nino34_3m = nino34_sst.rolling(time=3, center=True).mean()

#计算加权异常值
nino34_anom = nino34_sst.groupby('time.month') - climatology

# 计算3个月的滑动平均异常值
nino34_3m_anom = nino34_3m.groupby('time.month') - climatology
```

2.2 [10 points] Visualize the computed Niño 3.4. Your plot should look similar to this one.

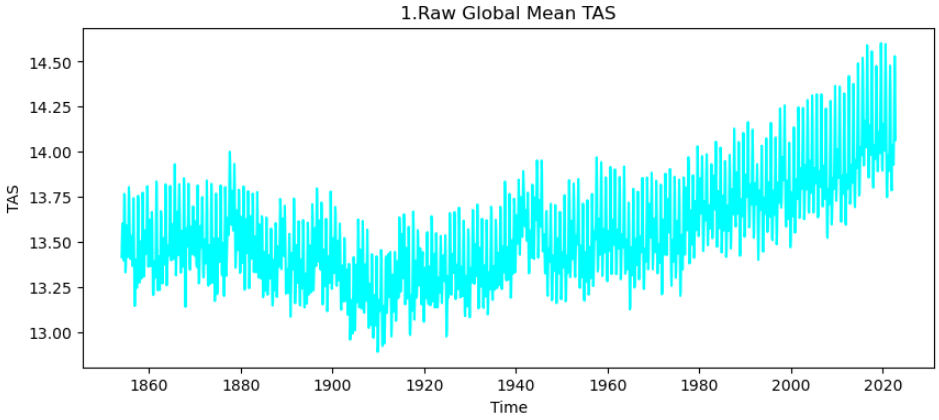


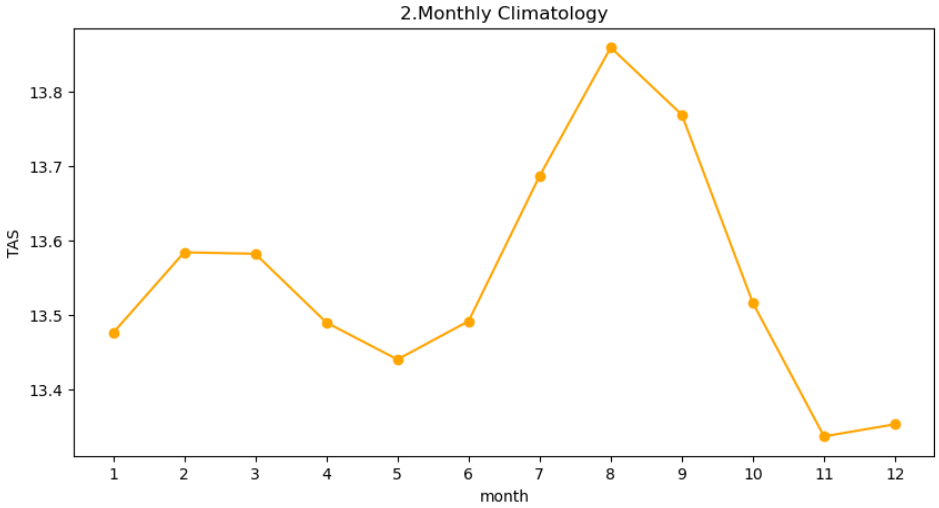
3. Explore a netCDF dataset

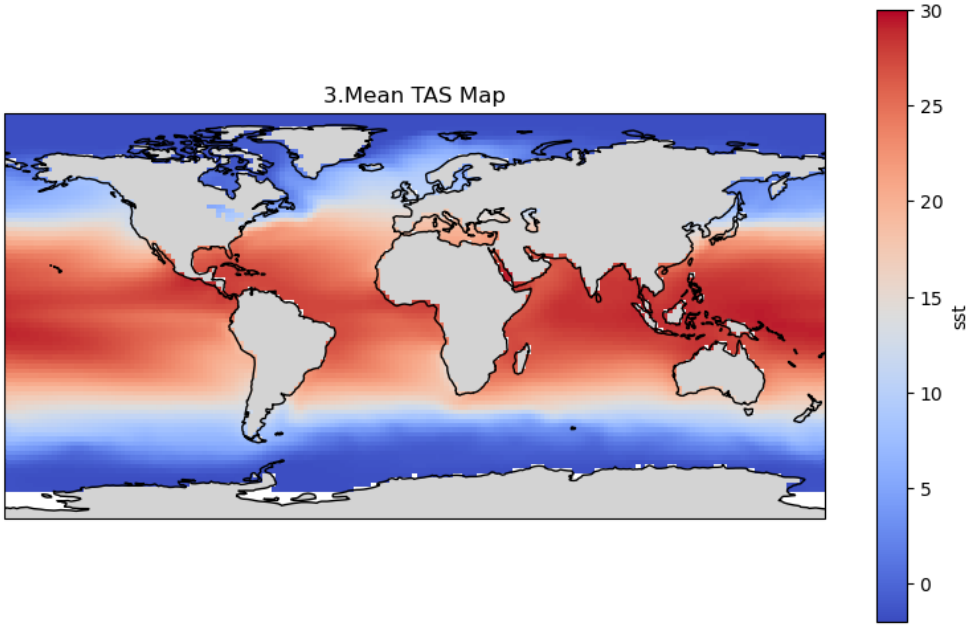
3.1 [5 points] Plot a time series of a certain variable with monthly seasonal cycle removed.

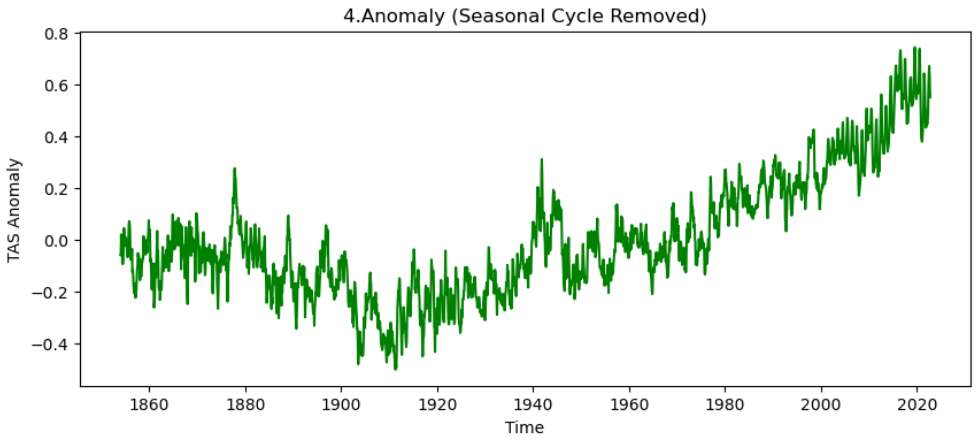


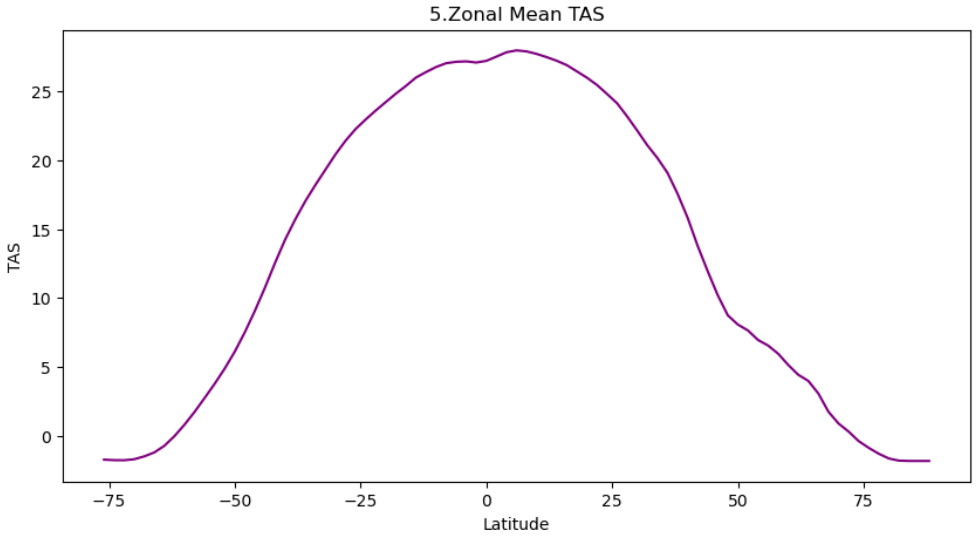
3.2 [10 points] Make at least 5 different plots using the dataset.








4.Anomaly (Seasonal Cycle Removed)
TAS Anomaly
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
1860
1880
1900
1920
1940
1960
1980
2000
2020
Time


5.Zonal Mean TAS
TAS
25
20
15
10
5
0
−75
−50
−25
0
25
50
75
Latitude