

1. Global methane levels from 2002

先打开文件

xarray.Dataset

Dimensions: (time: 210, bnds: 2, lat: 36, lon: 72, pressure: 10)

Coordinates:

| | | | | |
|------|--------|----------------|-----------------------------------|--|
| time | (time) | datetime64[ns] | 2003-01-16T12:00:00 ... 2020-0... | |
| lat | (lat) | float64 | -87.5 -82.5 -77.5 ... 82.5 87.5 | |
| lon | (lon) | float64 | -177.5 -172.5 ... 172.5 177.5 | |

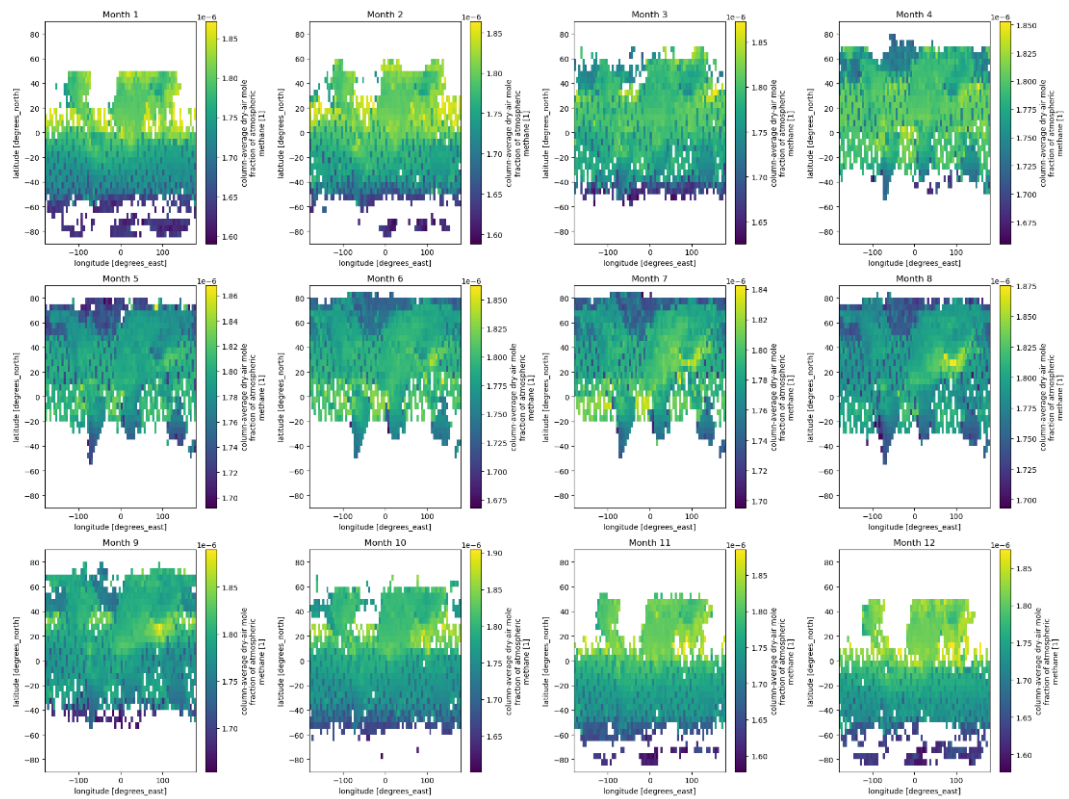
Data variables:

| | | | | |
|-------------------|----------------------------|----------------|-----|--|
| time_bnds | (time, bnds) | datetime64[ns] | ... | |
| lat_bnds | (lat, bnds) | float64 | ... | |
| lon_bnds | (lon, bnds) | float64 | ... | |
| pre | (pressure) | float64 | ... | |
| pre_bnds | (pressure, bnds) | float64 | ... | |
| land_fraction | (lat, lon) | float64 | ... | |
| xch4 | (time, lat, lon) | float32 | ... | |
| xch4_nobs | (time, lat, lon) | float64 | ... | |
| xch4_stderr | (time, lat, lon) | float32 | ... | |
| xch4_stddev | (time, lat, lon) | float32 | ... | |
| column_averag... | (time, pressure, lat, lon) | float32 | ... | |
| vmr_profile_ch... | (time, pressure, lat, lon) | float32 | ... | |

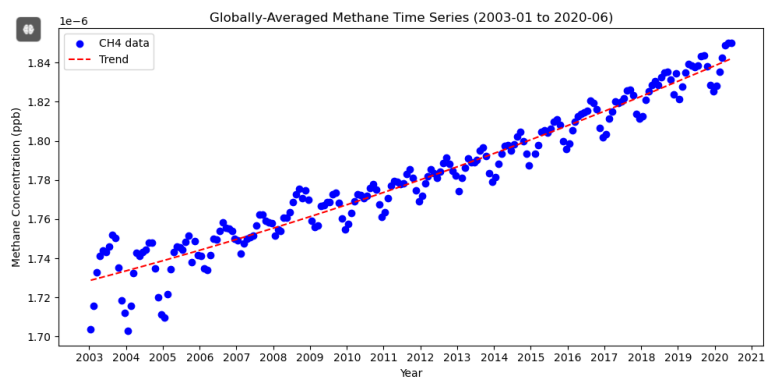
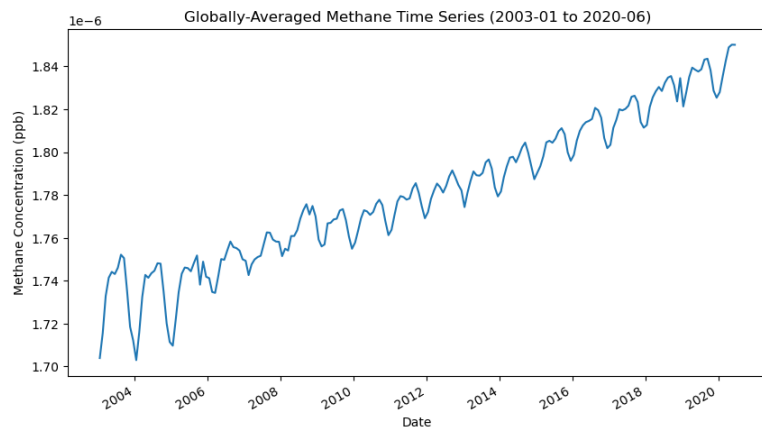
Indexes: (3)

Attributes: (28)

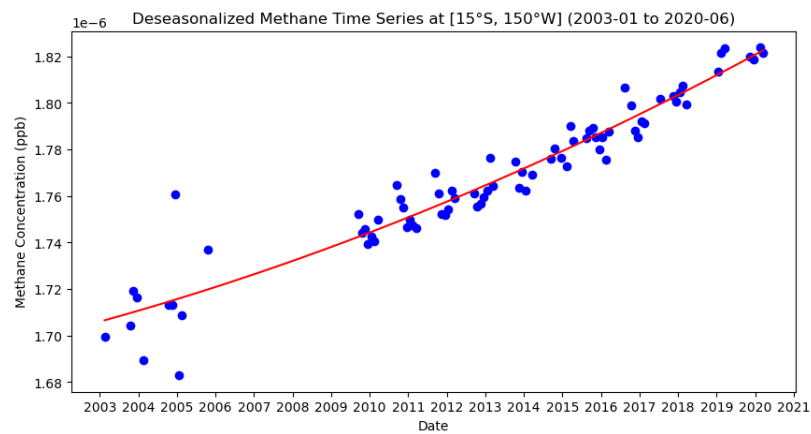
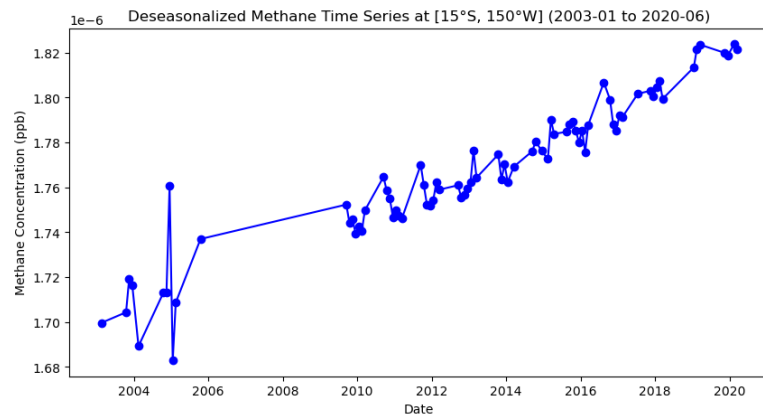
1.1 通过月份 groupby



1.2 和图片趋势一样，动态上升



1.3 结果显示动态上升



2. Niño 3.4 index

先打开文件

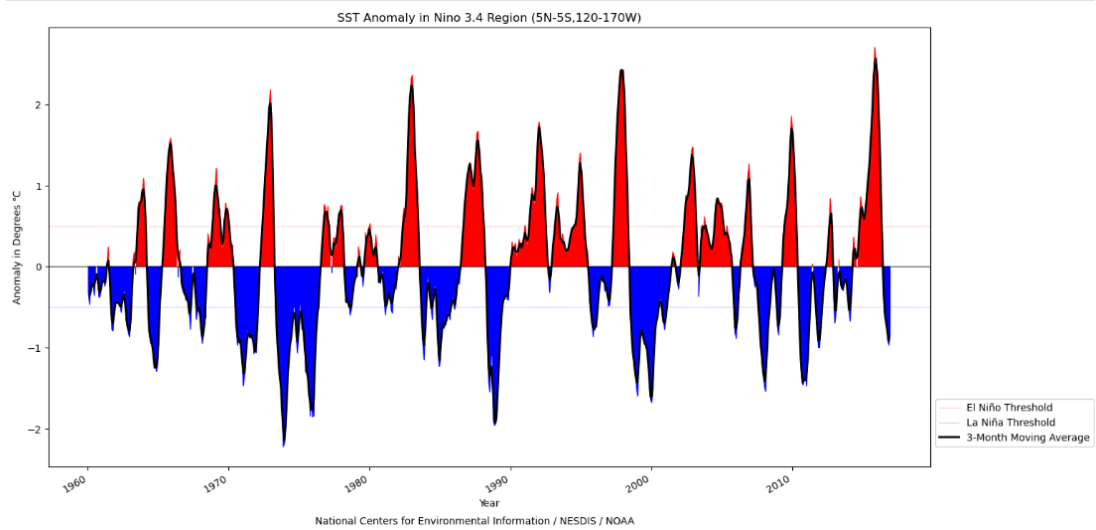
xarray.Dataset

| | |
|-----------------|---|
| Dimensions: | (lat: 89, lon: 180, time: 684) |
| Coordinates: | |
| lat | (lat) float32 -88.0 -86.0 -84.0 ... 86.0 88.0 |
| lon | (lon) float32 0.0 2.0 4.0 ... 354.0 356.0 358.0 |
| time | (time) datetime64[ns] 1960-01-15 ... 2016-12-15 |
| Data variables: | |
| sst | (time, lat, lon) float32 ... |
| Indexes: (3) | |
| Attributes: | |
| Conventions : | IRIDL |
| source : | https://iridl.ldeo.columbia.edu/SOURCES/.NOAA/.NCDC/.ERSST/.version3b/.sst/ |
| history : | extracted and cleaned by Ryan Abernathey for Research Computing in Earth Science |

2.1 得到结果如下：

```
(<xarray.DataArray (month: 12)>
  array([[26.567791, 26.742277, 27.239607, 27.693747, 27.795218, 27.59776 ,
          27.198921, 26.824205, 26.737833, 26.717144, 26.693289, 26.613096],
        dtype=float32)
Coordinates:
  * month      (month) int64 1 2 3 4 5 6 7 8 9 10 11 12,
<xarray.DataArray (time: 684)>
  array([-3.1966972e-01, -4.6856880e-01, -2.6817322e-01, -1.8702698e-01,
        -1.7763329e-01, -3.5774994e-01, -1.4202499e-01,  1.4617920e-02,
        -1.5233040e-01, -3.7995529e-01, -3.6094475e-01, -2.0870590e-01,
        -1.9146347e-01, -1.3425446e-01, -2.4034500e-01, -1.8515396e-01,
         5.1975250e-02,  2.3946571e-01, -7.0287704e-02, -4.1871262e-01,
        -7.7839279e-01, -7.9244804e-01, -4.9628067e-01, -4.1731834e-01,
        -4.4483185e-01, -4.5603943e-01, -4.3614388e-01, -4.6699524e-01,
        -5.6461143e-01, -4.2693138e-01, -2.7675629e-01, -3.1725311e-01,
        -6.7326164e-01, -6.6616821e-01, -8.1782341e-01, -8.6558533e-01,
        -7.0150185e-01, -3.5710335e-01,  6.9654465e-02,  1.7343712e-01,
        -9.0732574e-02,  7.6885223e-02,  6.8776703e-01,  7.9541397e-01,
         7.1307945e-01,  8.3437920e-01,  9.0870476e-01,  1.0861340e+00,
         8.5174370e-01,  5.2354431e-01, -1.3051987e-01, -6.3452911e-01,
        -8.6223221e-01, -9.4615173e-01, -7.8432274e-01, -1.0945091e+00,
        -1.2546921e+00, -1.1899929e+00, -1.2921047e+00, -1.2049026e+00,
        -7.8304100e-01, -3.6871910e-01, -1.1257362e-01, -7.6622009e-02,
         2.6844406e-01,  5.9128571e-01,  8.1219864e-01,  1.2383175e+00,
         1.2778320e+00,  1.5245876e+00,  1.5834160e+00,  1.4413567e+00,
         1.1761131e+00,  9.1285896e-01,  9.7410202e-01,  5.4810143e-01,
        -1.2728691e-01,  1.6879463e-01,  2.0802307e-01, -1.7561722e-01,
        ...
        -1.4302368e+00, -1.4568272e+00, -1.3761215e+00, -1.3509674e+00,
        -1.4733887e+00, -1.0575485e+00, -8.5629463e-01, -4.8648262e-01,
        -1.4340019e-01,  4.3134689e-02, -1.1228752e-01, -3.0133247e-01,
        -5.8121872e-01, -7.4657059e-01, -9.9734688e-01, -1.0020943e+00,
        -7.0126343e-01, -5.6642532e-01, -3.0149460e-01, -1.5209389e-01,
        -8.4617615e-02,  7.5967789e-02,  1.7238235e-01,  3.8050842e-01,
         8.3662605e-01,  6.2762451e-01,  4.9790573e-01, -3.8330841e-01,
        -6.9582176e-01, -5.4938698e-01, -3.6759758e-01,  9.5283508e-02,
        -3.9381027e-02, -2.3508835e-01, -2.6667786e-01, -2.9703903e-01,
        -2.1478271e-01, -8.1573486e-02, -1.5825462e-01, -3.9179039e-01,
        -5.3815079e-01, -6.7158508e-01, -3.8124657e-01,  2.2390366e-02,
         3.6442375e-01,  2.0833015e-01,  8.7995529e-02, -1.8939972e-03,
         2.5484848e-01,  5.1874924e-01,  8.6029434e-01,  7.2361374e-01,
         6.2315941e-01,  5.4422760e-01,  5.9342384e-01,  9.0473747e-01,
         1.0039616e+00,  1.1428738e+00,  1.4043026e+00,  1.6557541e+00,
         1.9150295e+00,  2.3241348e+00,  2.7027397e+00,  2.5220909e+00,
         2.4621906e+00,  2.1432362e+00,  1.6182098e+00,  1.1510773e+00,
         4.6403885e-01, -1.1242294e-01, -5.6766701e-01, -6.4799690e-01,
        -6.4021492e-01, -8.9692116e-01, -9.7106361e-01, -8.5552597e-01],
        dtype=float32)
Coordinates:
  * time      (time) datetime64[ns] 1960-01-15 1960-02-15 ... 2016-12-15
    month     (time) int64 1 2 3 4 5 6 7 8 9 10 11 ... 2 3 4 5 6 7 8 9 10 11 12)
```

2.2 画出相似图



3. 使用了助教提供的样本

3.1 先获取数据有的变量

Variables in the file:

XCO2

XCO2PREC

lat

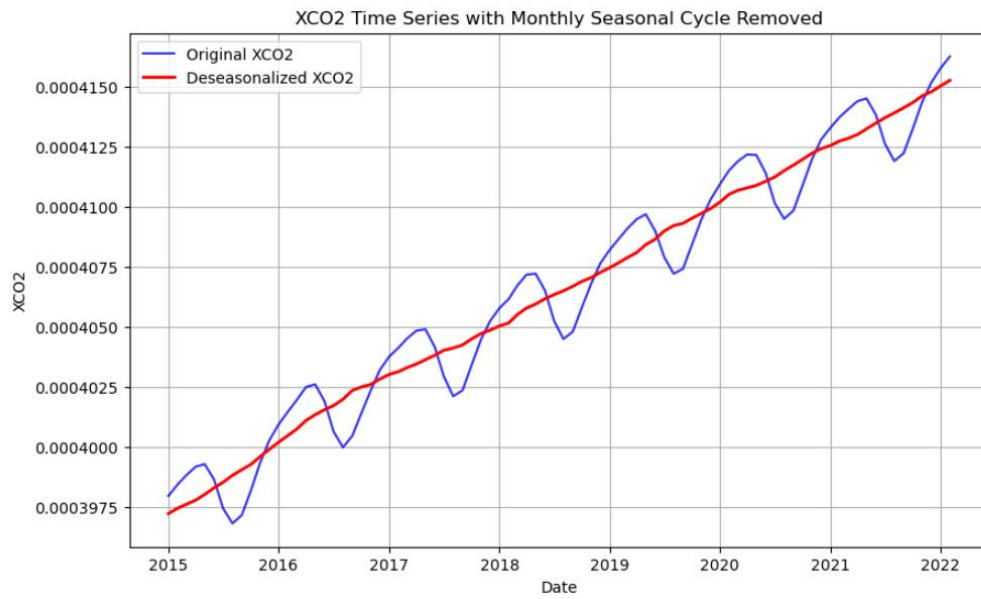
lon

time

通过创建一个空字典，用于存储时间和对应的 XCO2 平均值，以便后续数据处理

```
[82]: {'2015-01': 0.00039796826485955183,
'2015-02': 0.00039845149601055904,
'2015-03': 0.0003988250209472504,
'2015-04': 0.00039917714090489633,
'2015-05': 0.0003992907825065787,
'2015-06': 0.000398648994236562,
'2015-07': 0.00039744816917165466,
'2015-08': 0.0003968212589242938,
'2015-09': 0.00039716908870620043,
'2015-10': 0.00039818414635090106,
'2015-11': 0.00039935116385761334,
'2015-12': 0.0004002732622317736,
'2016-01': 0.0004009385726106052,
'2016-02': 0.0004014733677147184,
'2016-03': 0.0004019537435347103,
'2016-04': 0.00040249511087986616,
'2016-05': 0.0004026069669729845,
'2016-06': 0.000401896852989735,
'2016-07': 0.0004006384790831488,
'2016-08': 0.00039998300171913283,
'2016-09': 0.0004004655540181946,
'2016-10': 0.00040140277463867485,
'2016-11': 0.00040234865988523144,
'2016-12': 0.0004031980402131462,
'2017-01': 0.0004037565372764677,
'2017-02': 0.0004041298061249722,
'2017-03': 0.00040450766158228583,
'2017-04': 0.00040483780009608266,
'2017-05': 0.0004048939638843707,
'2017-06': 0.0004041593290878096,
'2017-07': 0.0004029387061192242,
'2017-08': 0.000402111389348627,
'2017-09': 0.000402355588017103,
'2017-10': 0.0004034023430794999,
'2017-11': 0.00040446174550031307,
'2017-12': 0.0004052281815235634,
'2018-01': 0.0004057702221676568,
'2018-02': 0.0004061522156039459,
'2018-03': 0.0004067075354069877,
'2018-04': 0.0004071672903104408,
'2018-05': 0.00040720589955761823,
'2018-06': 0.0004065086337043094,
'2018-07': 0.000405251800099599,
'2018-08': 0.0004044899178102954,
'2018-09': 0.0004047936040930438,
'2018-10': 0.0004057931703973114,
'2018-11': 0.00040678792557115025,
'2018-12': 0.00040763105142535154,
'2019-01': 0.0004081880975672462,
'2019-02': 0.0004086635361076758,
'2019-03': 0.00040908267100117445,
'2019-04': 0.0004094760557892189,
'2019-05': 0.0004096784363176508,
'2019-06': 0.0004089850174822225,
'2019-07': 0.00040789633290942023,
'2019-08': 0.00040720390874572025,
'2019-09': 0.0004074101405290718,
'2019-10': 0.00040841963173964506,
'2019-11': 0.00040946192424057444,
'2019-12': 0.00041027953938892897,
'2020-01': 0.000410917031613449,
'2020-02': 0.00041150590569495507,
'2020-03': 0.0004118808926585222,
'2020-04': 0.0004121647024132691,
'2020-05': 0.00041214089743806995,
'2020-06': 0.000411393979764349,
'2020-07': 0.00041014235092507194,
'2020-08': 0.00040948552552757156,
'2020-09': 0.0004098338891832004,
'2020-10': 0.00041087097706128716,
'2020-11': 0.0004119558303290017,
'2020-12': 0.00041277372423712195,
'2021-01': 0.0004132689942105764,
'2021-02': 0.0004137209342348723,
'2021-03': 0.0004140400879558466,
'2021-04': 0.0004143808183546014,
'2021-05': 0.0004144930904431473,
'2021-06': 0.00041381548932323975,
'2021-07': 0.00041260881581890523,
'2021-08': 0.000411889345026032,
'2021-09': 0.00041221886131160256,
'2021-10': 0.00041322883848913156,
'2021-11': 0.00041434282327283494,
'2021-12': 0.00041514085690352317,
'2022-01': 0.00041574999903038916,
'2022-02': 0.000416240169161574}
```

从字典中提取相关数据绘图



3.2 参考 Section_08.ipynb Exercise #1, 从字典中提取相关数据绘图

