PS3.ipynb

1. Niño 3.4 index

1.1

The nino3.4 region is selected according to the description of the question, and the average is taken by month groups, and the anomalies are calculated according to the algorithm given in the question.

```python
#1.1
Nino_34=Nino.sel(lon=slice(190,240),lat=slice(-5,5))
```
[5] ✓ 0.0s

```python
climatology=Nino_34.groupby('time.month').mean(dim='time')
```
[6] ✓ 0.0s

```python
#计算所有异常值
anomalies=Nino_34.groupby('time.month')-climatology
```
[7] ✓ 0.0s

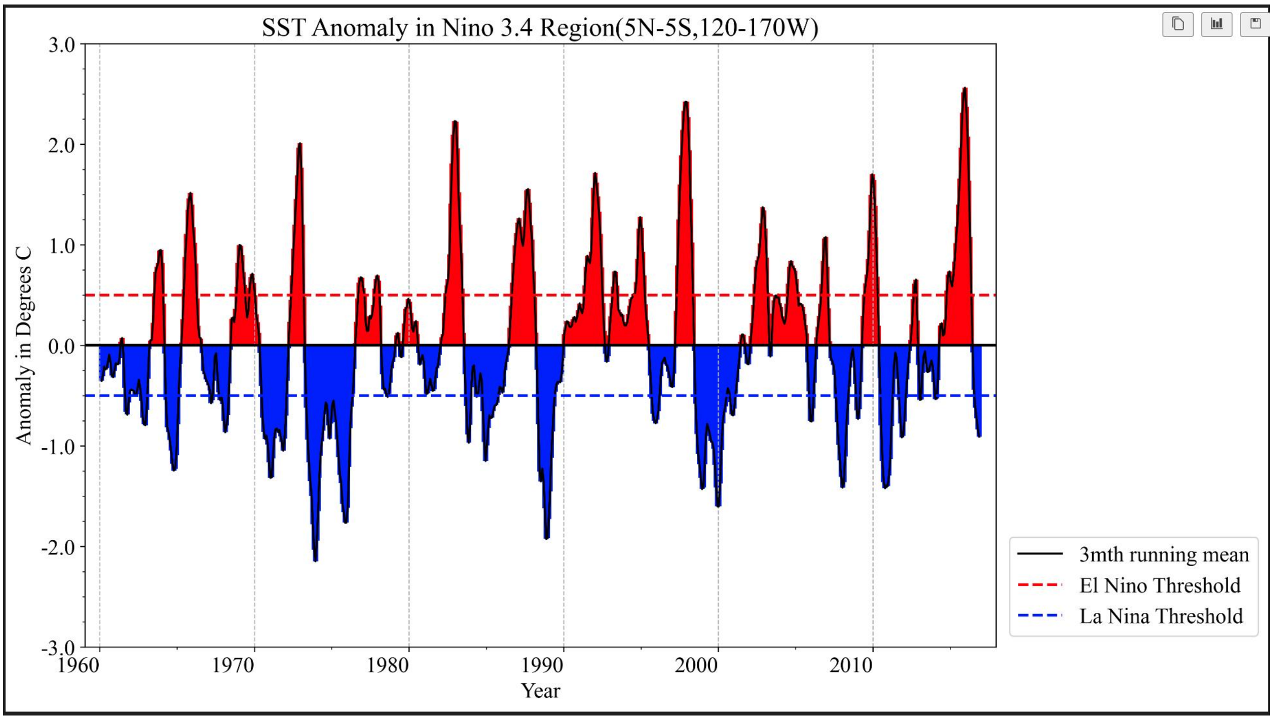
```
xarray.Dataset

► Dimensions:        (lat: 5, lon: 26, time: 684)
▼ Coordinates:
   lat      (lat)                float32   -4.0 -2.0 0.0 2.0 4.0
   lon      (lon)                float32   190.0 192.0 194.0 ... 238.0 240.0
   time     (time)       datetime64[ns]   1960-01-15 ... 2016-12-15
   month    (time)                 int64   1 2 3 4 5 6 7 ... 6 7 8 9 10 11 12
▼ Data variables:
   sst      (time, lat, lon)     float32   -0.4316 -0.4185 ... -0.3004 -0.1988
► Indexes: (3)
► Attributes: (0)
```

1.2

According to the error report, I learned that the Dataset should be converted to DataArray before drawing a two-dimensional graph. I learned the.rolling() method from CSDN.(Record:.mean(['lat','lon']) to obtain the Nino anomalies at each time point in the region (time,month,lat,lon).)

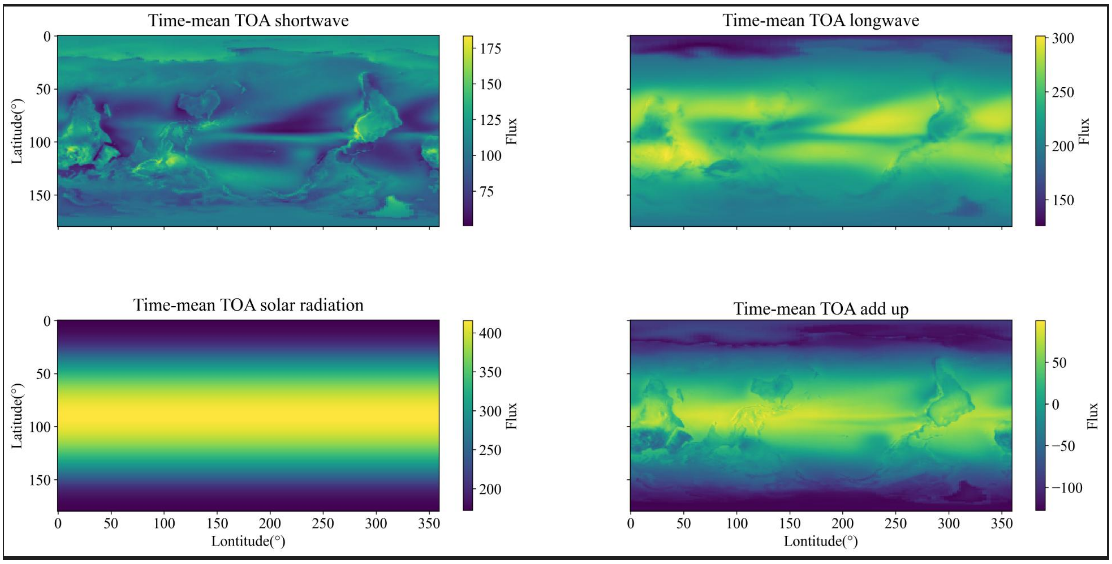
Then is the drawing process, in order to meet the requirements of the reference picture as much as possible, the time is first converted into a standard form and recorded in the *time_series*, and then the primary and secondary scales are set in both the x axis and the y axis, and finally a part of the gap is left in the front and back of the x axis.

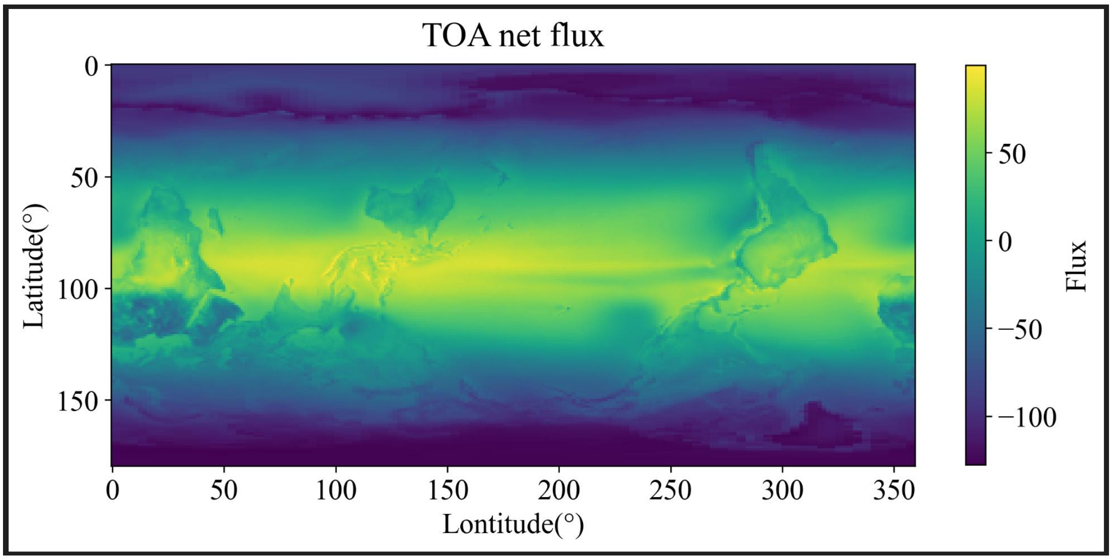


2. Earth's energy budget

2.1

Read the information of the Dataset, obtain TOA longwave, shortwave, and solar radiation for all-sky conditions according to the information, and average the time. Then calculate the addition according to the picture description. Finally, compare net flux.





So they are equivalent to the TOA net flux.

2.2

The data set has divided the Earth into several grids, and we can initialize all the grids so that they are all 1. And then we calculate the surface area of each grid and we get a mathematical formula to figure out the surface area of each grid.

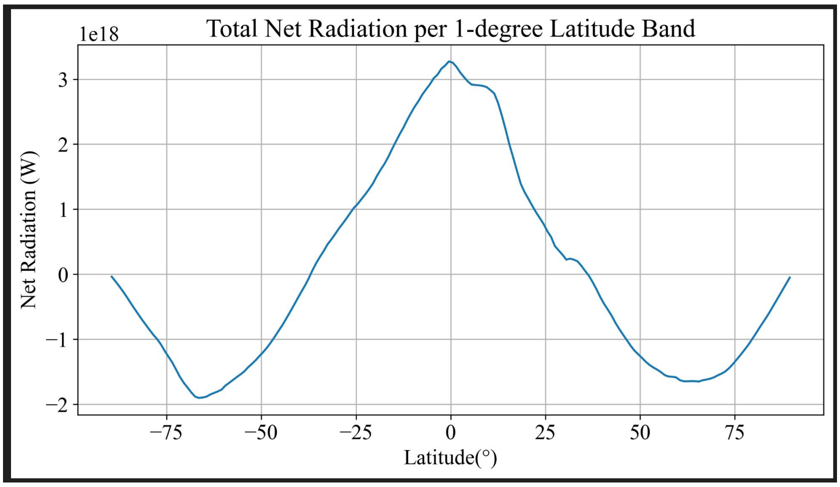
$$A = R^2 \times \cos(\mathrm{lat}) \times \Delta\mathrm{lon} \times \Delta\mathrm{lat}$$

Since the radius of the earth is kilometers, the unit conversion was finally done. Finally, the radiation value of each grid is averaged over the total surface area of the Earth to obtain the final data.

```
Incoming solar radiation: 340.2850341796875 W/m^2
Outgoing longwave radiation: 240.4961395263672 W/m^2
Outgoing shortwave radiation: 98.21063232421875 W/m^2
```

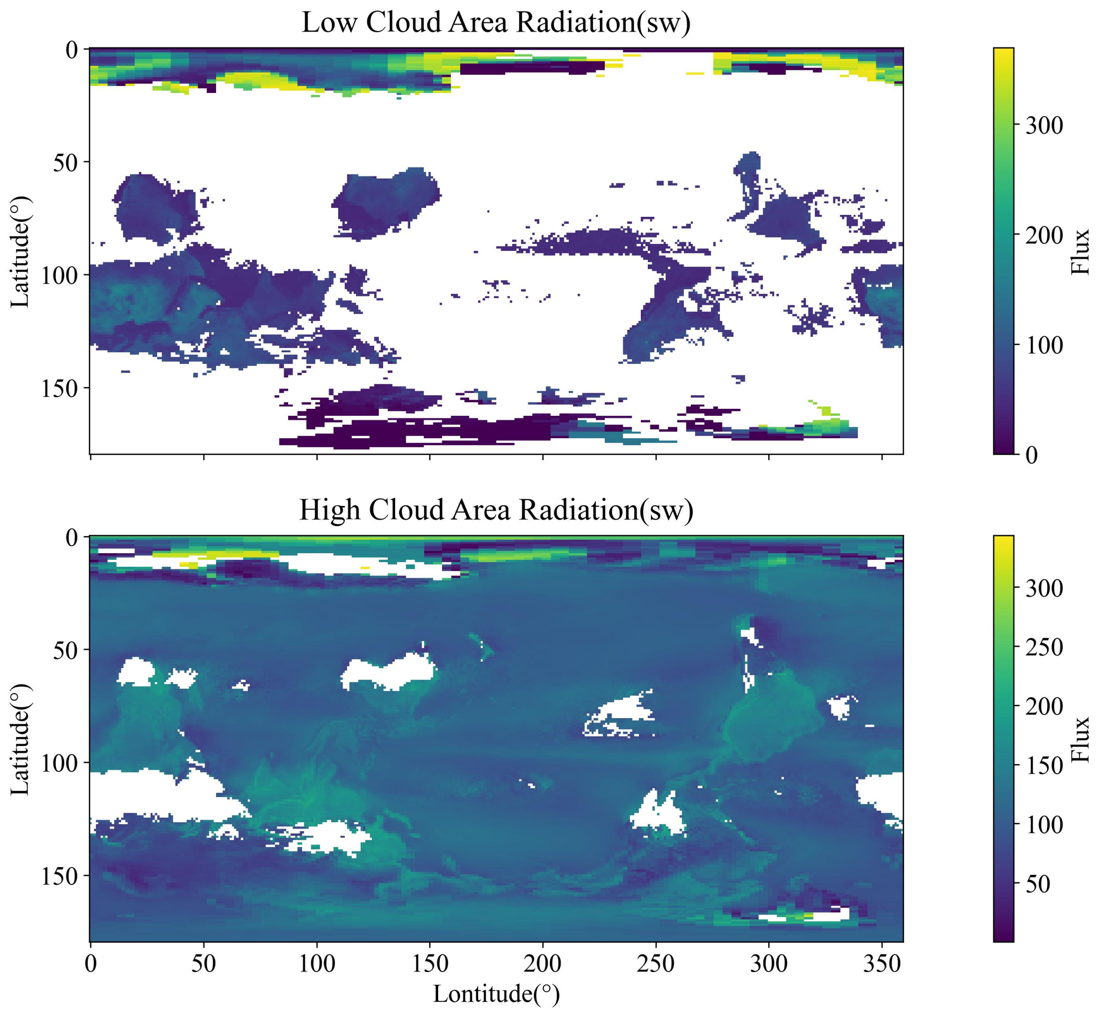
2.3

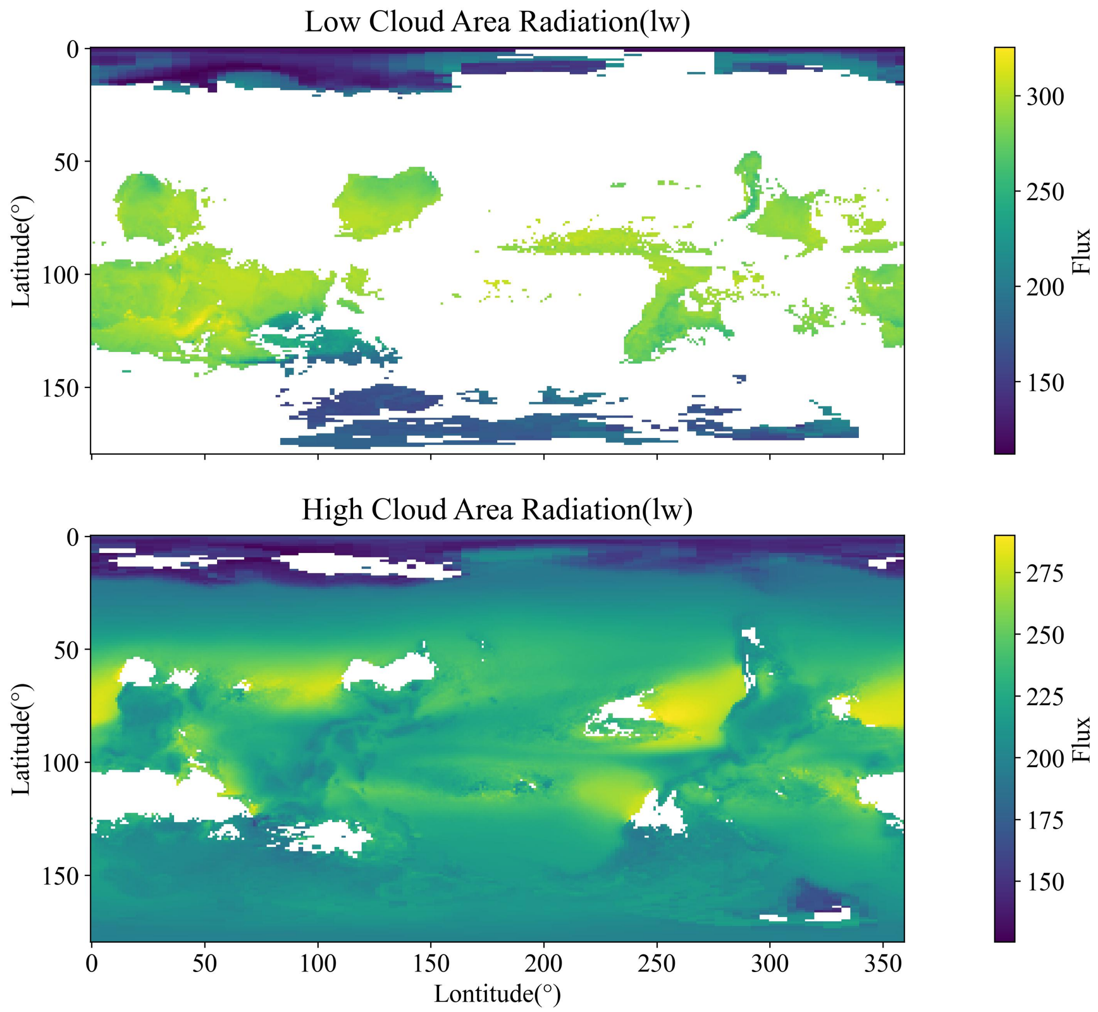
Since the area of each grid has already been calculated, this problem only needs to multiply the surface area of the different latitude zones according to the different latitude zones, and finally multiply by the radiation amount and take the sum.



2.4

According to the data set, the cloud area in all cases can be obtained first. Then according to the requirements of the topic on the cloud area to screen the radiation of the cloud area (< 25 and >75), and finally draw the pictures in groups.





2.5

From the data set, it is known that toa_cre_sw_mon, toa_cre_lw_mon, and toa_cre_net_mon represent the Cloud Radiative Effect (CRE) of short wave, long wave, and net radiation, respectively, that is, the influence of clouds on radiation balance. Calculate the amount of radiation for each grid in the high and low cloud regions, and then average the total surface area of the Earth to get the result.

```
Global mean values of shortwave in low cloud regions: 15.471146583557129 W/m^2
Global mean values of shortwave in high cloud regions: 106.16401672363281 W/m^2
Global mean values of longwave in low cloud regions: 57.25401306152344 W/m^2
Global mean values of longwave in high cloud regions: 214.81924438476562 W/m^2
```

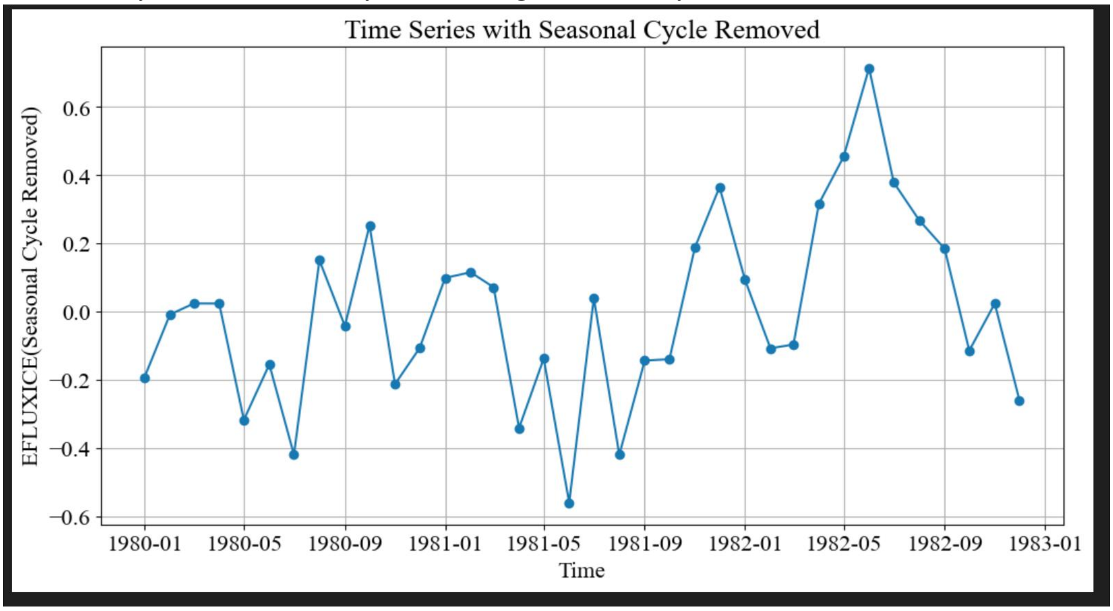
```
Overall effect of clouds on shortwave: -46.78656768798828 W/m^2
Overall effect of clouds on longwave: 27.956222534179688 W/m^2
```

3. Explore a netCDF dataset

Since the files found were broken down by year and month, multiple files were combined into one large nc file with a three-year time series.

3.1

Select the variable 'EFLUXICE'. EFLUXICE is a numerical model specifically designed to study and analyze electromagnetic wave propagation in frozen environments such as glaciers, ice sheets, and ice flows. Extract the time series and calculate the global average. Convert the time series to a DataFrame for subsequent processing. Extract the months and calculate the mean of the months. Finally, the seasonal cycle is removed by subtracting the monthly mean.



3.2

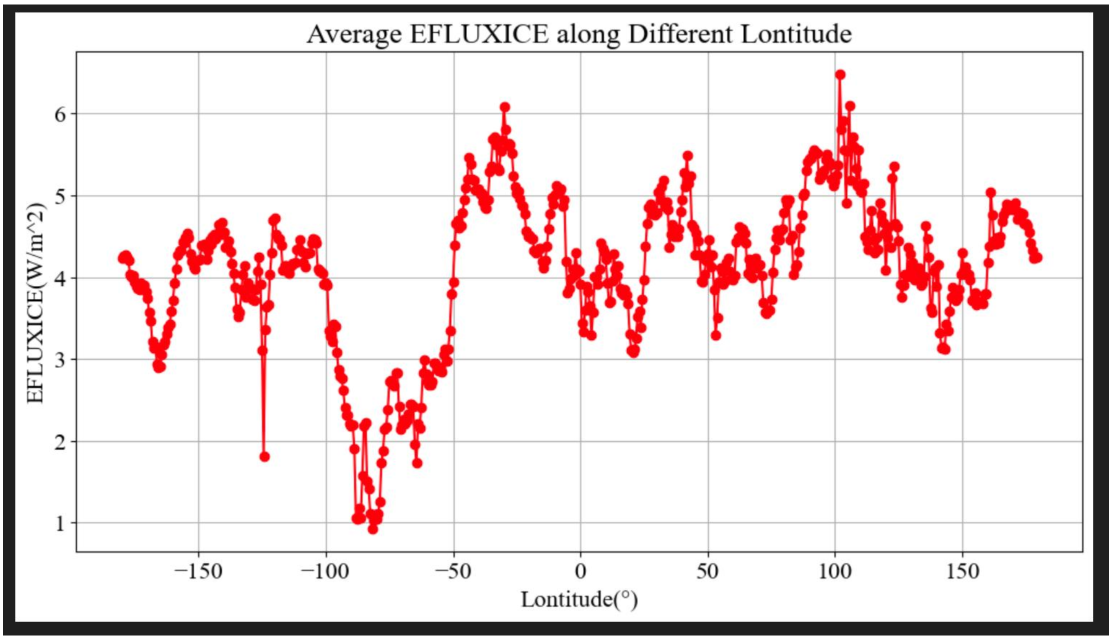


Fig1.Longitude averages of EFLUXICE

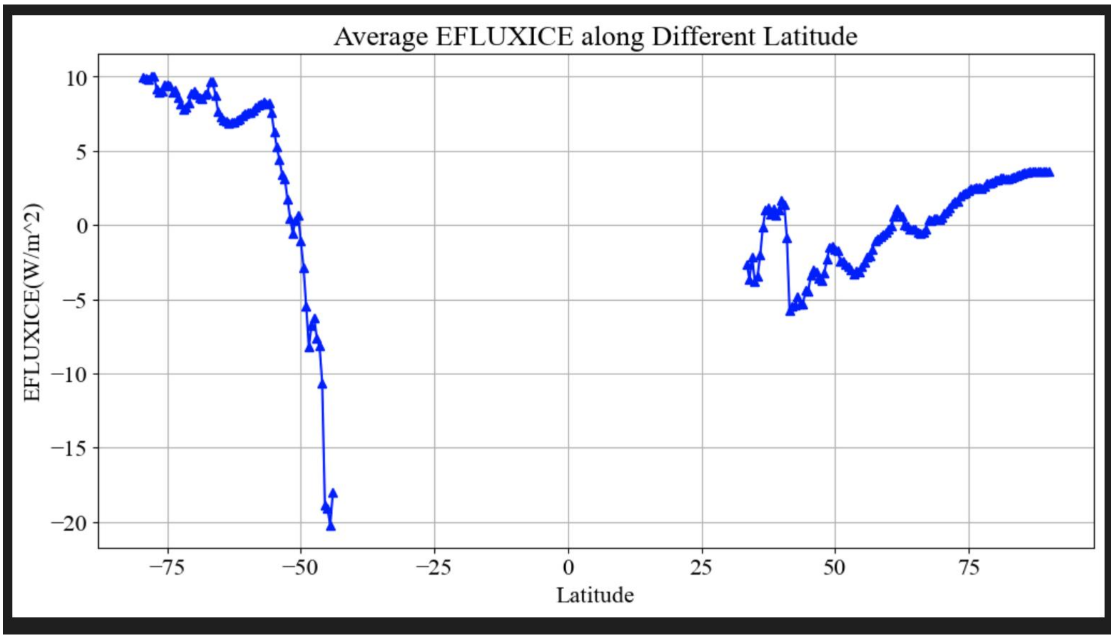


Fig2.Latitude mean map of EFLUXICE

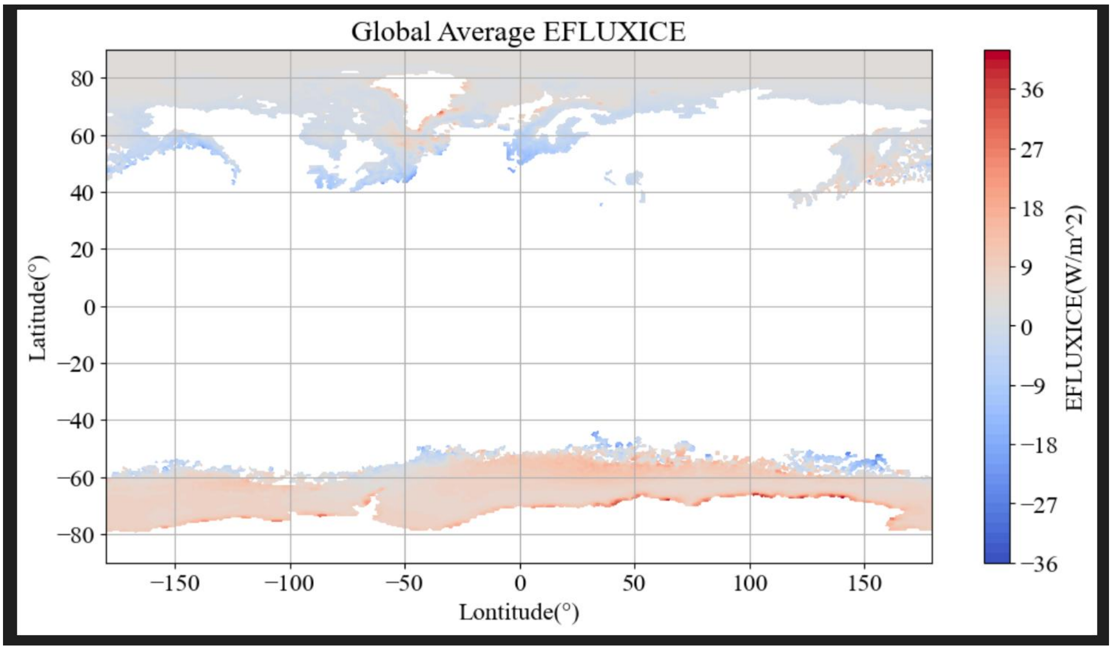


Fig3.Global mean map of EFLUXICE change

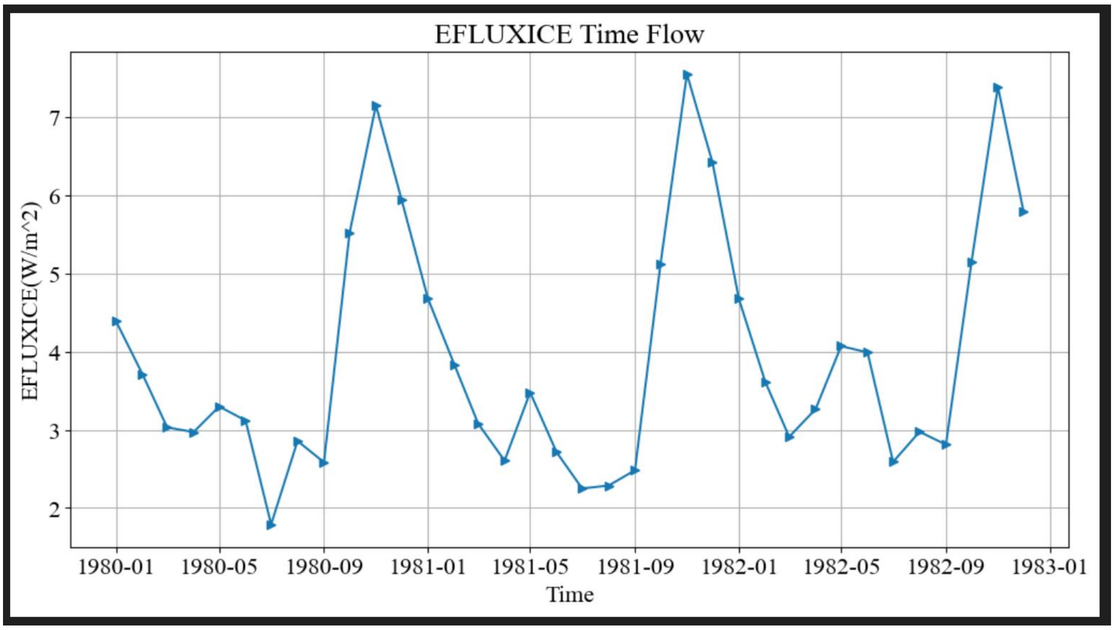


Fig4.Time variation diagram of EFLUXICE

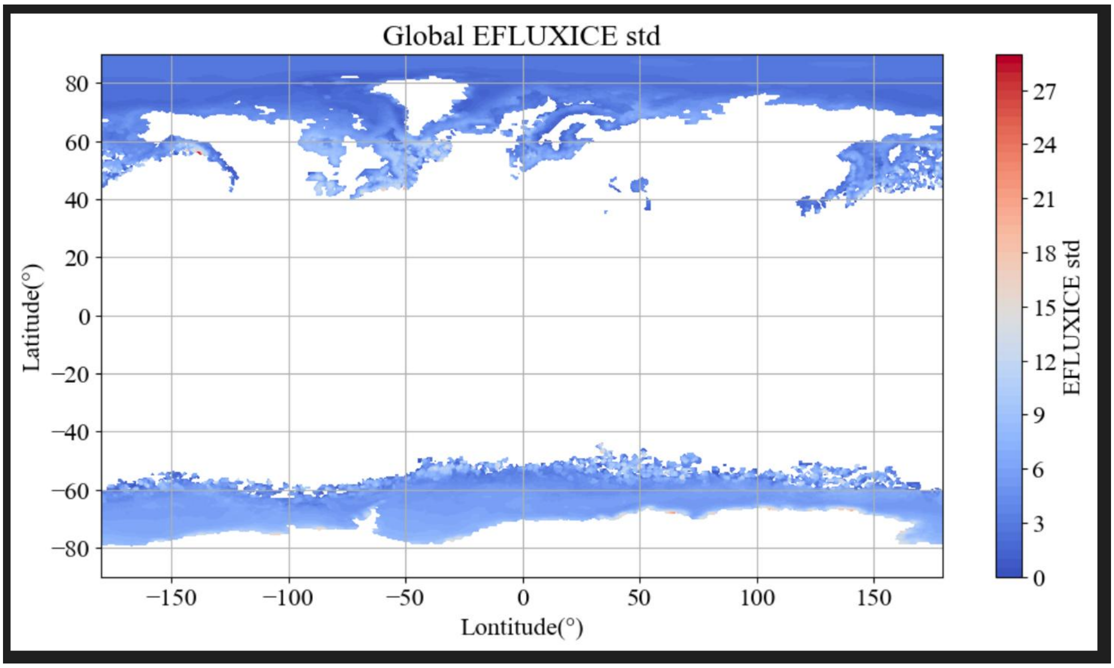
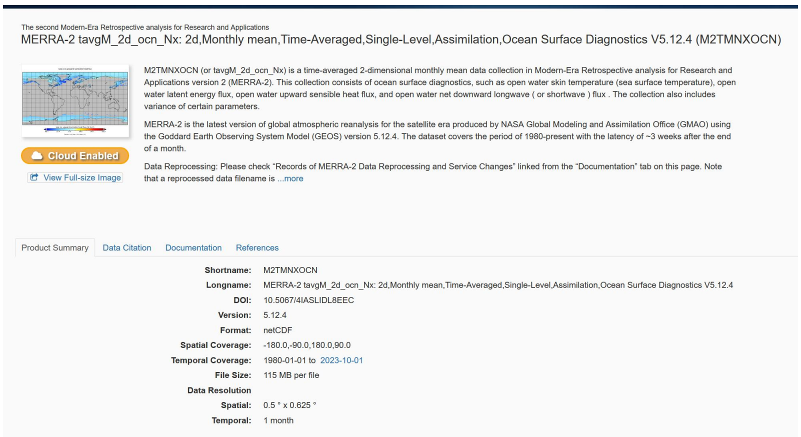


Fig5.EFLUXICE standard deviation chart”

Dataset information



The second Modern-Era Retrospective analysis for Research and Applications

MERRA-2 tavgM_2d_ocn_Nx: 2d,Monthly mean,Time-Averaged,Single-Level,Assimilation,Ocean Surface Diagnostics V5.12.4 (M2TMNXOCN)

M2TMNXOCN (or tavgM_2d_ocn_Nx) is a time-averaged 2-dimensional monthly mean data collection in Modern-Era Retrospective analysis for Research and Applications version 2 (MERRA-2). This collection consists of ocean surface diagnostics, such as open water skin temperature (sea surface temperature), open water latent energy flux, open water upward sensible heat flux, and open water net downward longwave (or shortwave) flux . The collection also includes variance of certain parameters.

MERRA-2 is the latest version of global atmospheric reanalysis for the satellite era produced by NASA Global Modeling and Assimilation Office (GMAO) using the Goddard Earth Observing System Model (GEOS) version 5.12.4. The dataset covers the period of 1980-present with the latency of ~3 weeks after the end of a month.

Data Reprocessing: Please check “Records of MERRA-2 Data Reprocessing and Service Changes” linked from the “Documentation” tab on this page. Note that a reprocessed data filename is ...more

Cloud Enabled

View Full-size Image

Product Summary | Data Citation | Documentation | References

Shortname:	M2TMNXOCN
Longname:	MERRA-2 tavgM_2d_ocn_Nx: 2d,Monthly mean,Time-Averaged,Single-Level,Assimilation,Ocean Surface Diagnostics V5.12.4
DOI:	10.5067/4IASLIDL8EEC
Version:	5.12.4
Format:	netCDF
Spatial Coverage:	-180.0,-90.0,180.0,90.0
Temporal Coverage:	1980-01-01 to 2023-10-01
File Size:	115 MB per file
Data Resolution	
Spatial:	0.5 ° x 0.625 °
Temporal:	1 month