In [3]:

```
import netCDF4
import xarray as xr
import numpy as np
import pandas as pd
import matplotlib as mpl
import matplotlib.pyplot as plt
import matplotlib.gridspec as gridspec
```

question 1

In [70]:

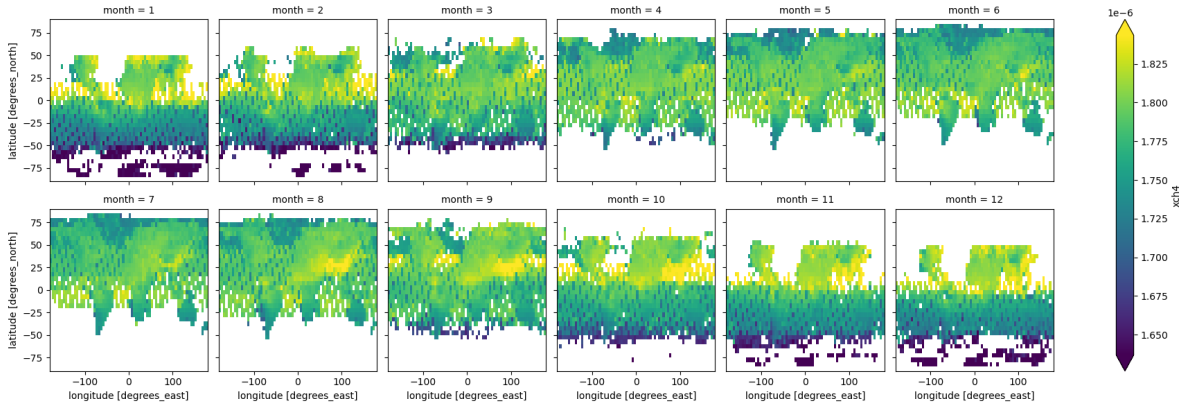
```
ds=xr.open_dataset("200301_202006-C3S-L3_GHG-PRODUCTS-OBS4MIPS-MERGED-v4.3.nc",engine="netcdf4")
```

In [71]:

```
ch4_clim =ds.xch4.groupby('time.month').mean()
ch4_clim.plot(col="month", col_wrap=6, robust=True)
```

Out[71]:

<xarray.plot.facetgrid.FacetGrid at 0x1ec8eaa4310>

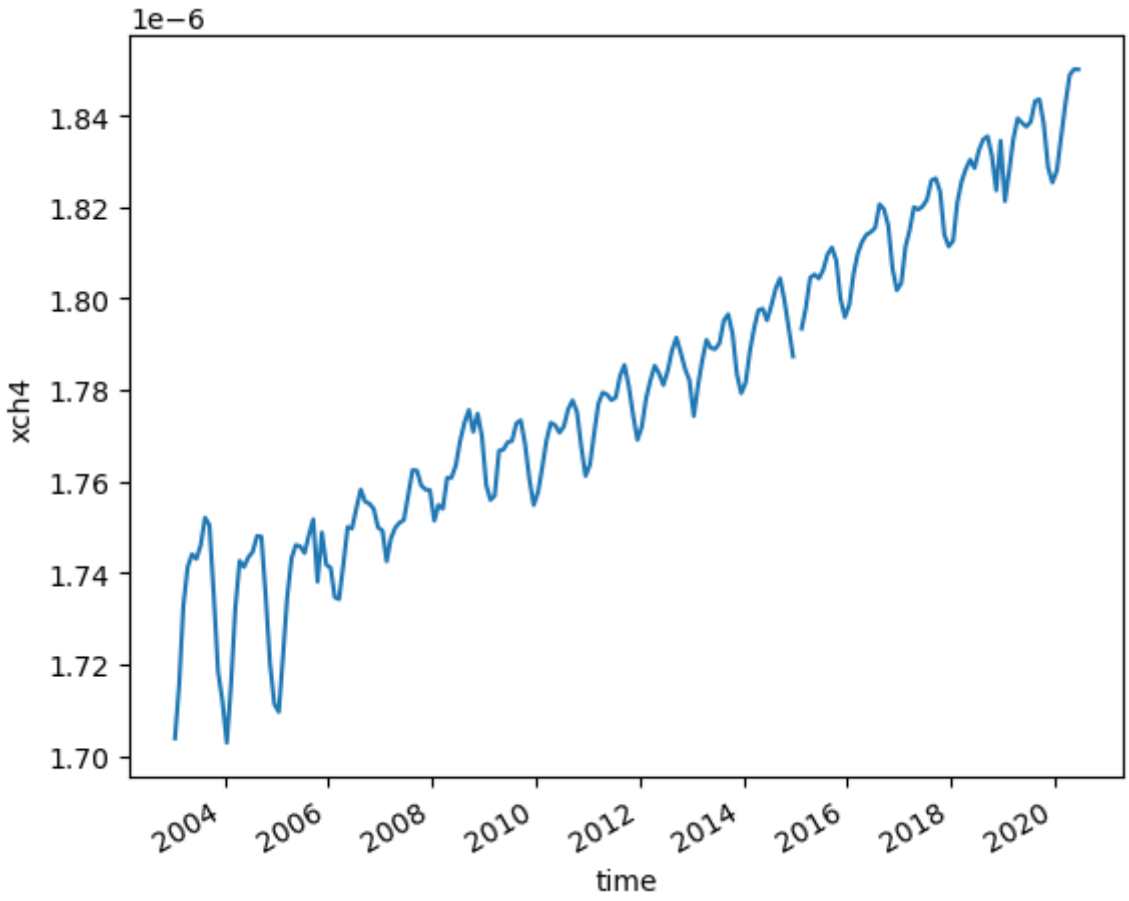


In [81]:

```
timelist=ds.xch4.sel(time=slice("2003-01","2020-06")).mean(["lon","lat"])
timelist.plot()
#lat=slice(-5, 5),lon=slice(-170,-120),
```

Out[81]:

```
[<matplotlib.lines.Line2D at 0x1ec8e7bf160>]
```



Global methane concentrations are fluctuating and may fluctuate in the short term, such as one to two years, but the overall trend has been increasing

In [74]:

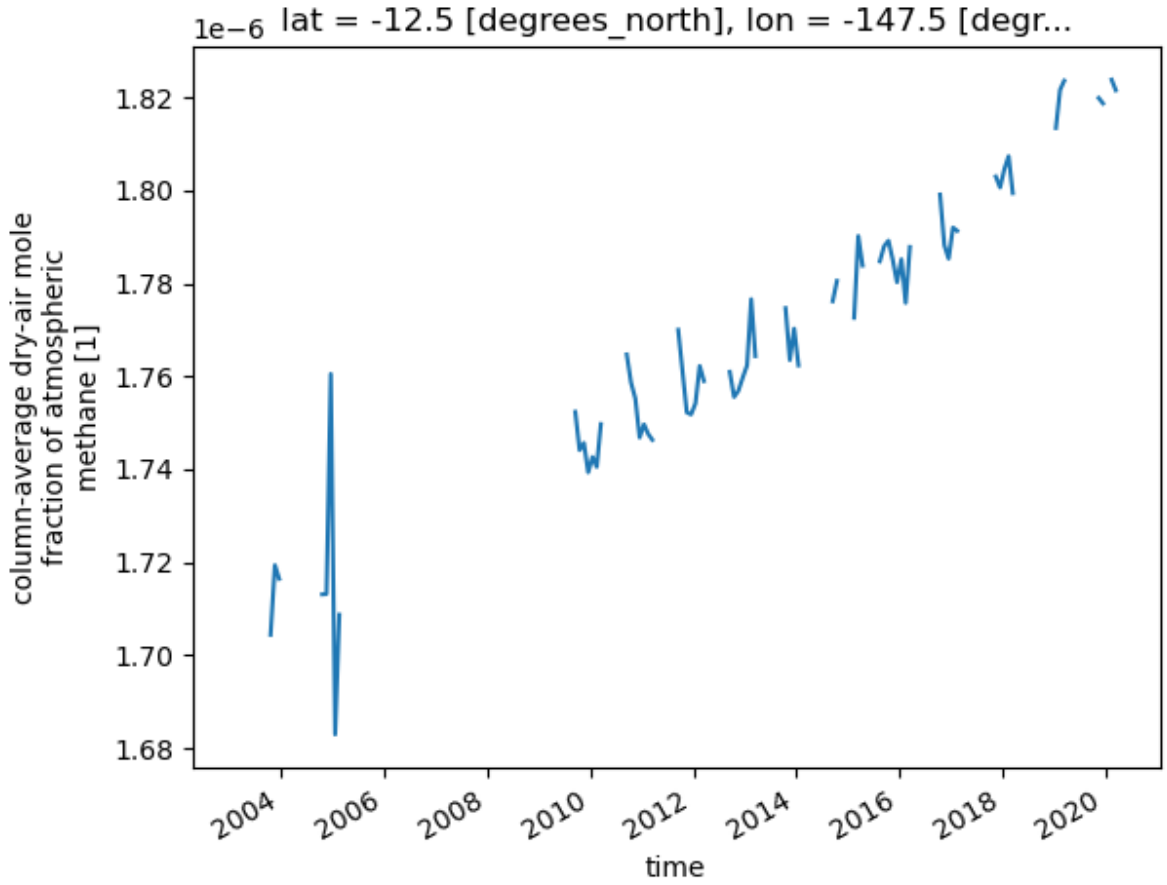
```
sitelist=ds.xch4.sel(lon=-150, lat=-15,method='nearest')

sitelist.plot()
```

```
D:\anaconda\lib\site-packages\xarray\core\indexes.py:234: FutureWarning: Passing met
hod to Float64Index.get_loc is deprecated and will raise in a future version. Use in
dex.get_indexer([item], method=...) instead.
  indexer = self.index.get_loc(
D:\anaconda\lib\site-packages\xarray\core\indexes.py:234: FutureWarning: Passing met
hod to Float64Index.get_loc is deprecated and will raise in a future version. Use in
dex.get_indexer([item], method=...) instead.
  indexer = self.index.get_loc(
```

Out[74]:

```
[<matplotlib.lines.Line2D at 0x1ec8eed0f10>]
```



Because data for this coordinate cannot be found for some time periods, the line chart looks choppy

question 2

In [76]:

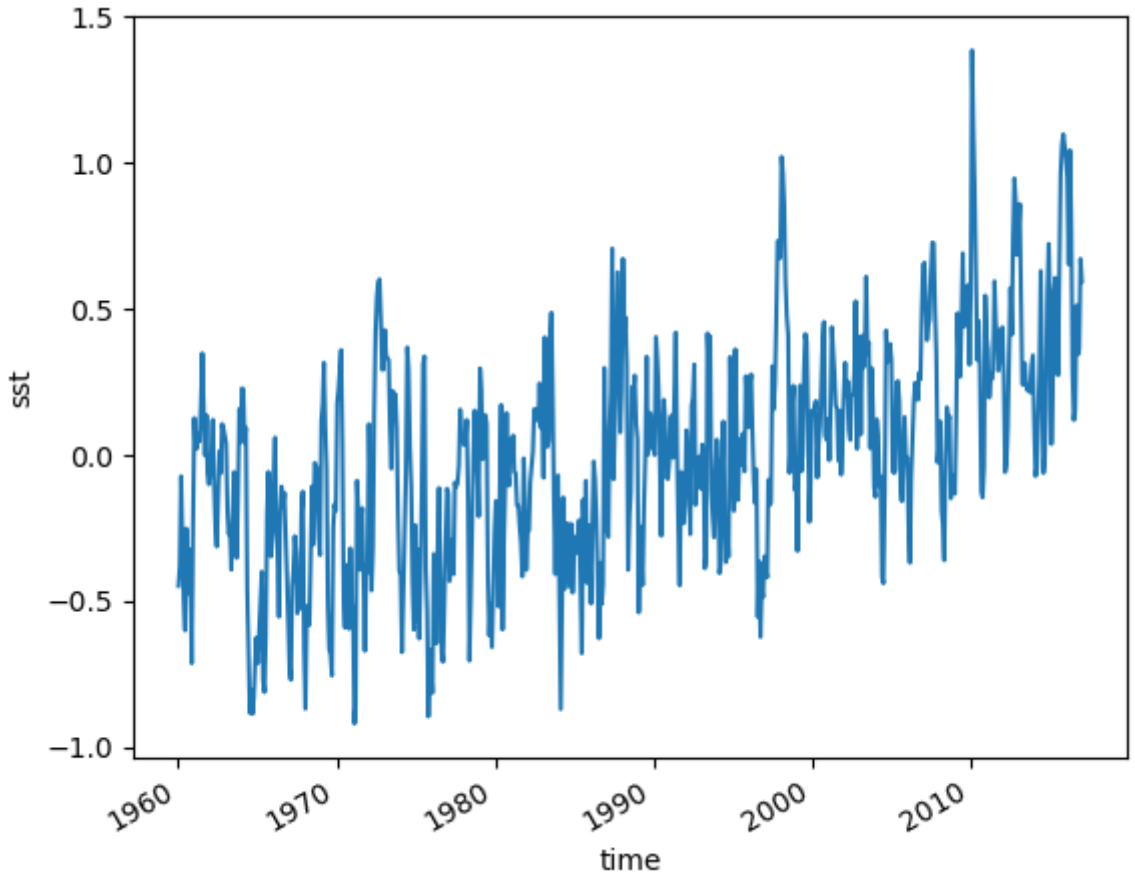
```
data = xr.open_dataset("NOAA_NCDC_ERSST_v3b_SST.nc", engine="netcdf4").sst.sel(lon=slice(10, 60),lat
```

In [77]:

```
#monthly anomaly
monthdata=data.groupby("time.month")
ano_series=monthdata-monthdata.mean(dim="time")
ano_series.mean(dim=['lon','lat']).plot()
```

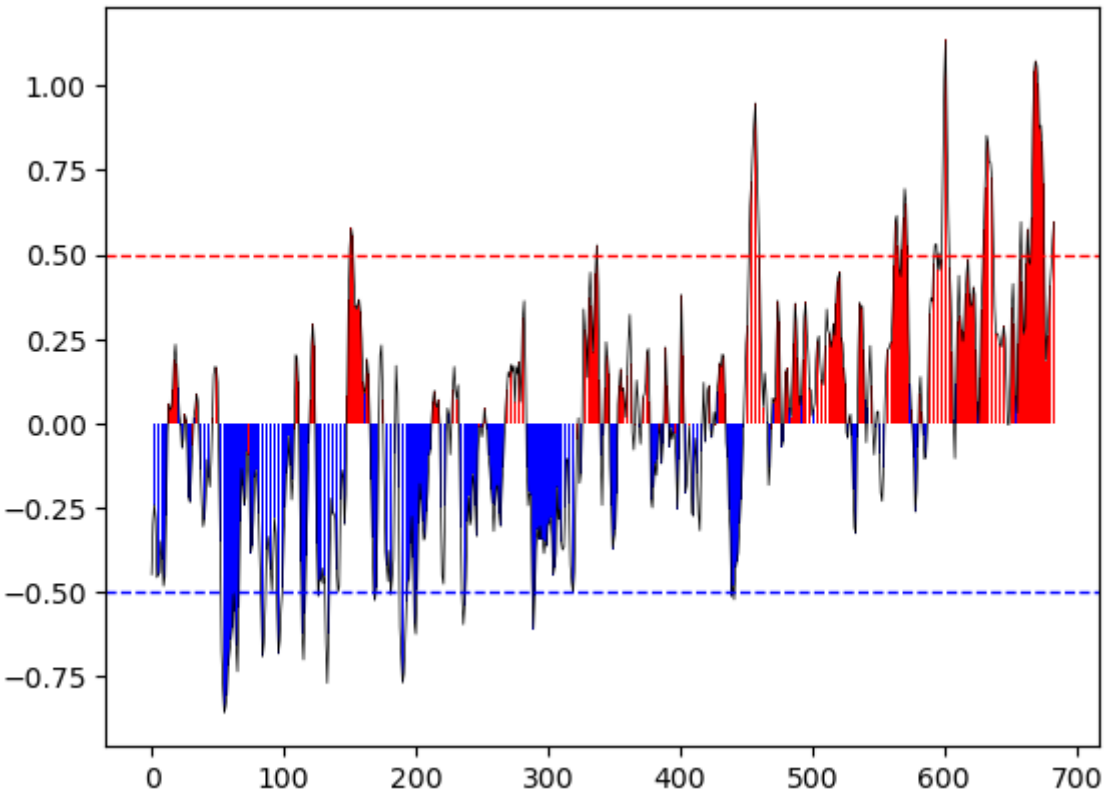
Out[77]:

[<matplotlib.lines.Line2D at 0x1ec8fb2e3d0>]



In [78]:

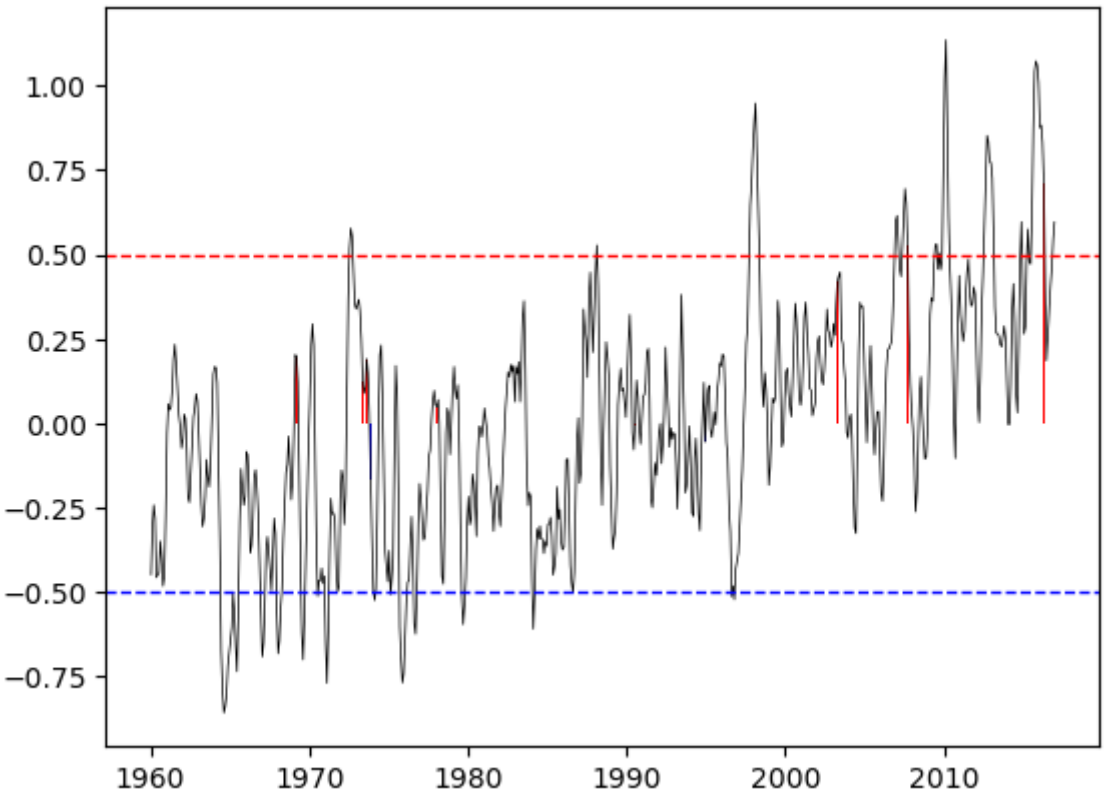
```
sst=ano_series.mean(dim=['lon','lat']).data
sst_3=[]
time=ano_series.mean(dim=['lon','lat']).time.data
for i in range(0,len(sst)):
    if i==0 or i==len(sst)-1:
        sst_3.append(sst[i])
    else:
        sst_3.append((sst[i-1]+sst[i]+sst[i+1])/3)
# plt.plot(time,sst_3,color='black')
sst_3=np.array(sst_3)
sst_3z=np.where(sst>0,sst_3,np.NAN)
sst_3f=np.where(sst<0,sst_3,np.NAN)
plt.bar(range(len(time)),sst_3z,color='red')
plt.bar(range(len(time)),sst_3f,color='blue')
plt.plot(range(len(time)),sst_3,color='black',linewidth=0.5)
plt.axhline(y=0.5,linestyle='--',linewidth=1, color='red')
plt.axhline(y=-0.5,linestyle='--',linewidth=1, color='blue')
plt.show()
```



The time coordinates are not set because the following problem occurs when using the time position x coordinate - the bar chart is not fully displayed, and I have not solved this problem yet

In [82]:

```
sst=ano_series.mean(dim=['lon','lat']).data
sst_3=[]
time=ano_series.mean(dim=['lon','lat']).time.data
for i in range(0,len(sst)):
    if i==0 or i==len(sst)-1:
        sst_3.append(sst[i])
    else:
        sst_3.append((sst[i-1]+sst[i]+sst[i+1])/3)
# plt.plot(time,sst_3,color='black')
sst_3=np.array(sst_3)
sst_3z=np.where(sst>0,sst_3,np.NAN)
sst_3f=np.where(sst<0,sst_3,np.NAN)
plt.bar(time,sst_3z,color='red')
plt.bar(time,sst_3f,color='blue')
plt.plot(time,sst_3,color='black',linewidth=0.5)
plt.axhline(y=0.5,linestyle='--',linewidth=1, color='red')
plt.axhline(y=-0.5,linestyle='--',linewidth=1, color='blue')
plt.show()
```



question 3

In [69]:

```
ds = xr.open_dataset("CESM2_200001-201412.nc", engine="netcdf4")
```

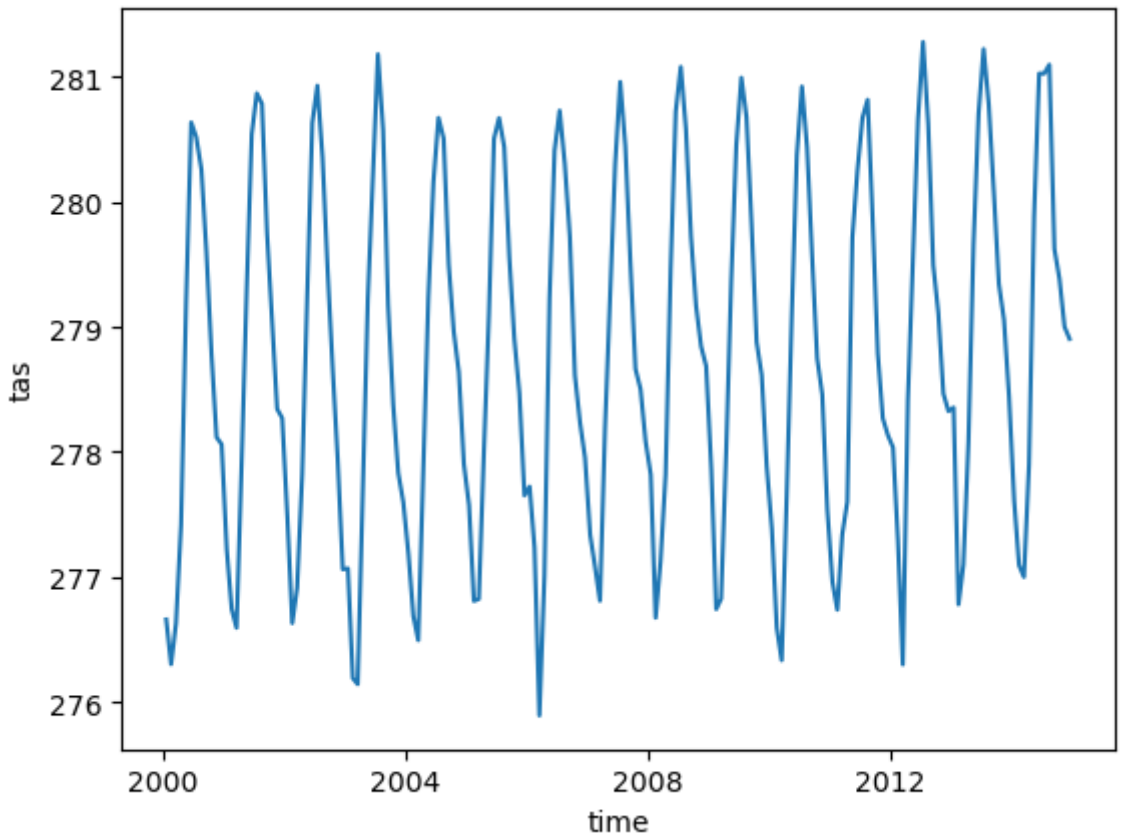
```
D:\anaconda\lib\site-packages\xarray\conventions.py:512: SerializationWarning: varia
ble 'tas' has multiple fill values {1e+20, 1e+20}, decoding all values to NaN.
  new_vars[k] = decode_cf_variable(
```

In [10]:

```
tas_clim = ds.tas.groupby('time.month').mean(dim=['lon','lat'])
tas_clim.plot()
```

Out[10]:

```
[<matplotlib.lines.Line2D at 0x2440b34a7f0>]
```

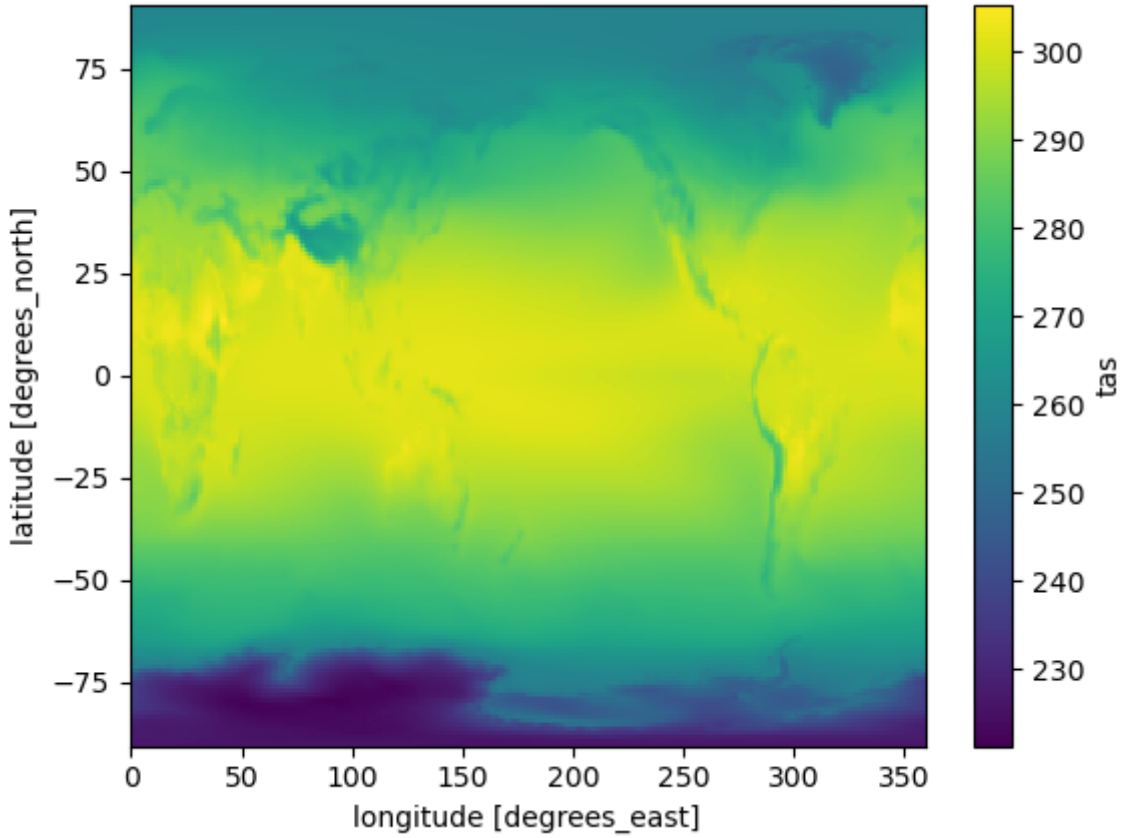


In [11]:

```
#average tas from 2000.01-2014.12
#figure 1
tas_mean=ds.tas.mean(dim='time')
tas_mean.plot()
```

Out[11]:

<matplotlib.collections.QuadMesh at 0x2440b3c9eb0>

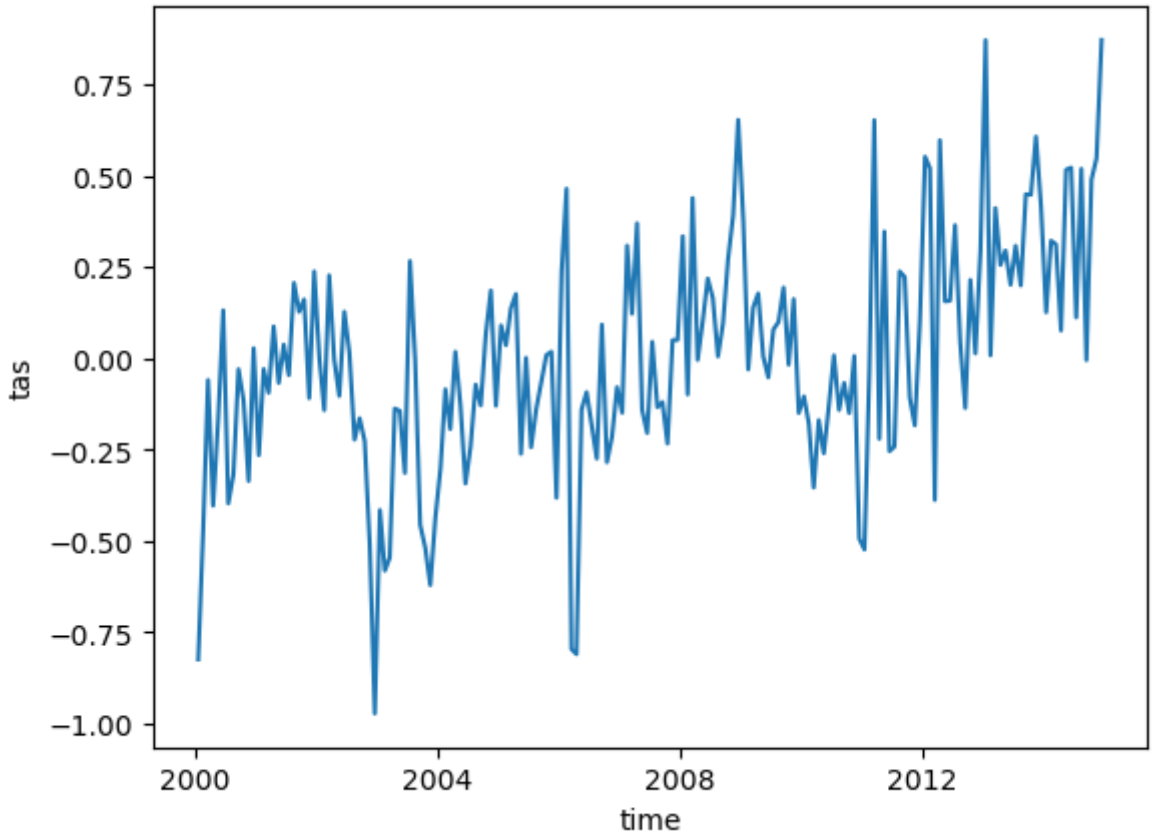


In [14]:

```
#monthly anomaly
#figure 2
monthdata=ds.tas.groupby("time.month")
ano_series=monthdata-monthdata.mean(dim="time")
ano_series.mean(dim=['lon','lat']).plot()
```

Out[14]:

```
[<matplotlib.lines.Line2D at 0x2440b599640>]
```

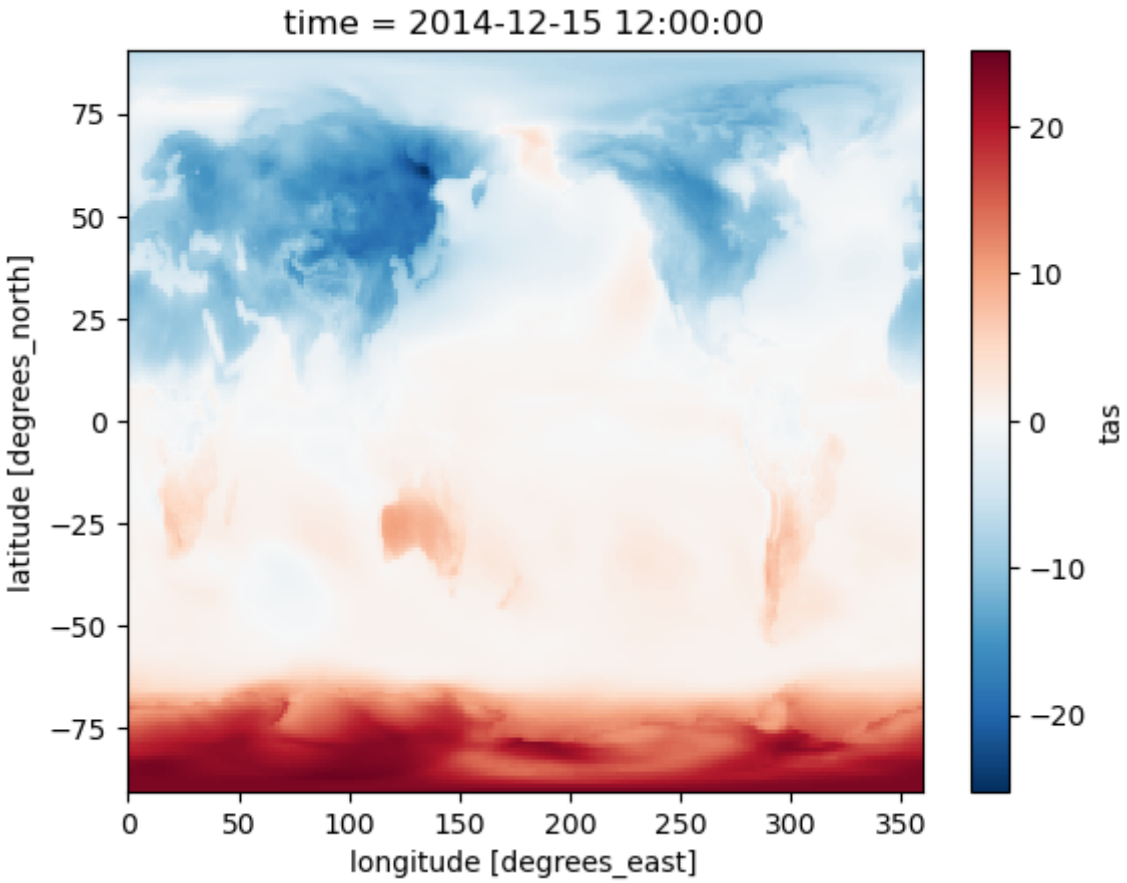


In [20]:

```
#latest day's tas anomaly
#figure 3
time_1=ds.tas.isel(time=-1)
time_1_ano=time_1-ds.tas.mean(dim=['time'])
time_1_ano.plot()
```

Out[20]:

<matplotlib.collections.QuadMesh at 0x2441117f310>

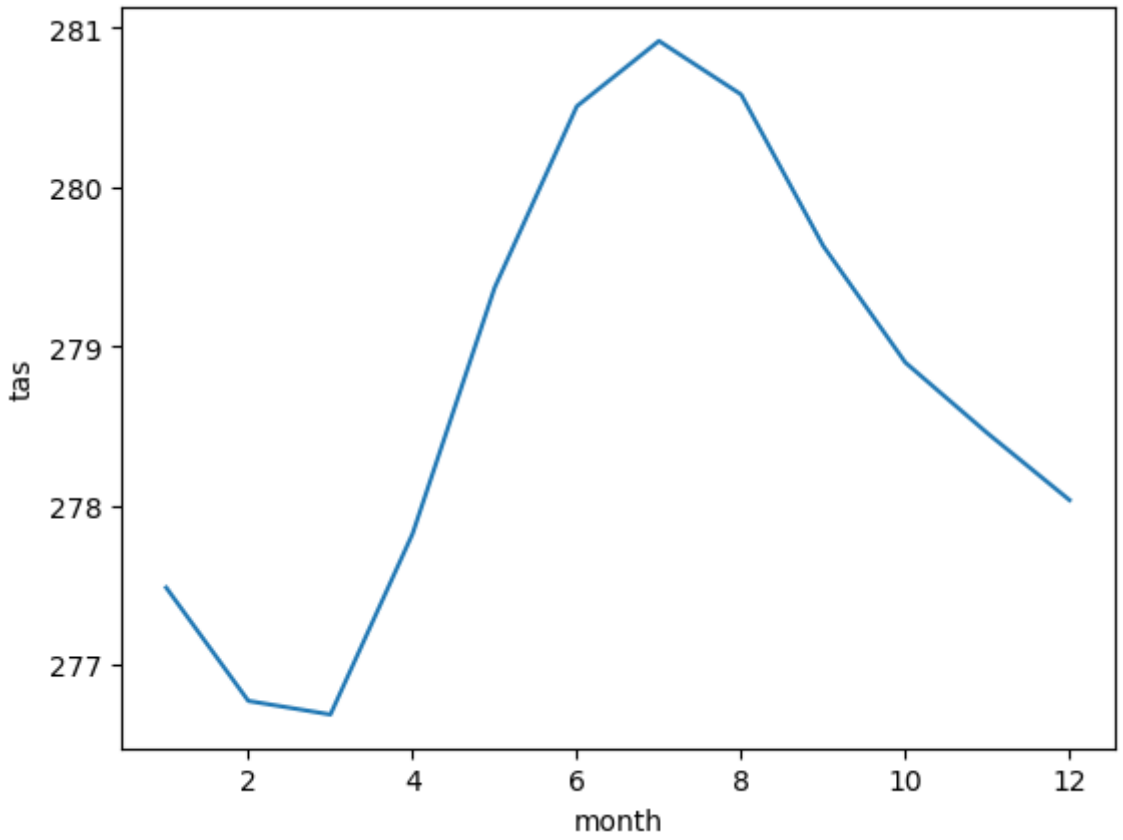


In [27]:

```
#the average change in different months from 2000 to 2014
#figure 4
ds.tas.groupby('time.month').mean(dim=['lon','lat',"time"]).plot()
```

Out[27]:

[<matplotlib.lines.Line2D at 0x24412b8da90>]

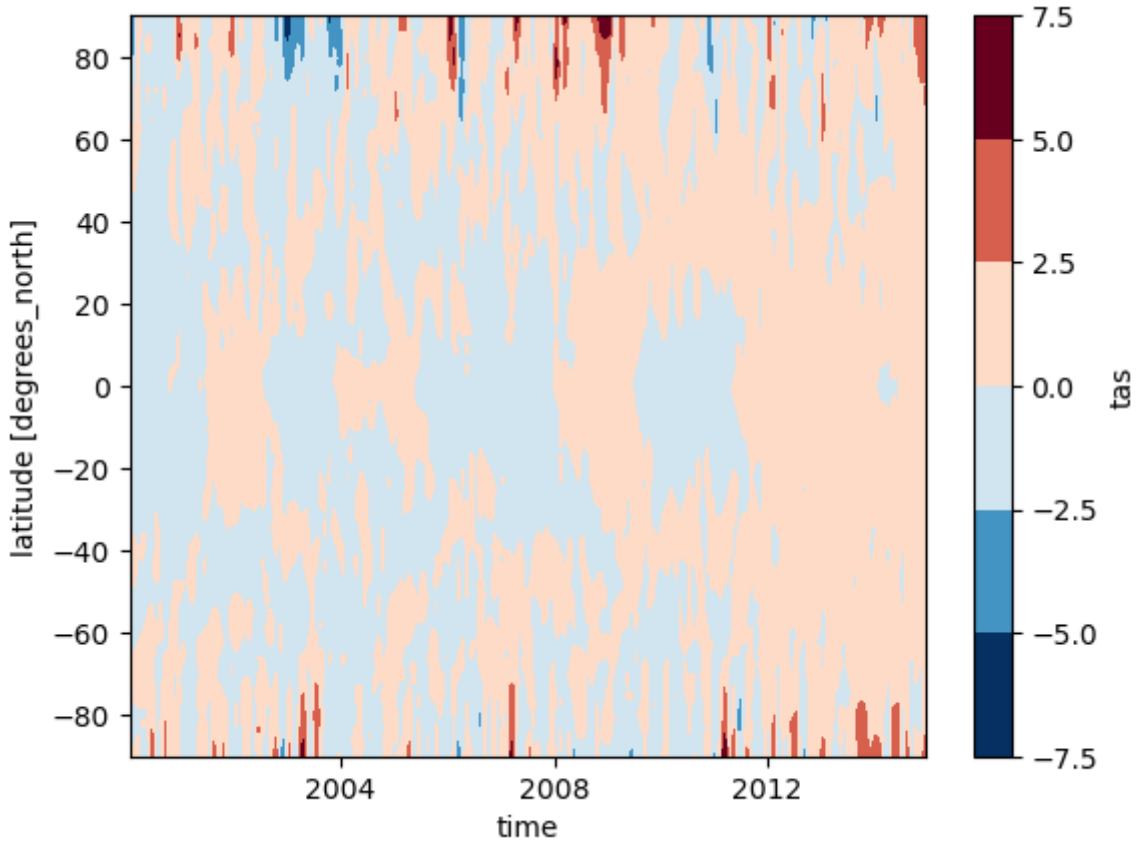


In [72]:

```
#monthly anomaly in latitude
#figure 5
monthdata=ds.tas.groupby("time.month")
ano_series=monthdata-monthdata.mean(dim="time")
ano_series.mean(dim=['lon']).transpose().plot.contourf()
```

Out[72]:

<matplotlib.contour.QuadContourSet at 0x24420025280>



In [ ]: