SIOC 221A: HW1

In [2]:

```
import numpy as np
import matplotlib.pyplot as plt
import netCDF4
import datetime as dt
import matplotlib.dates as mdates
import pandas as pd
```

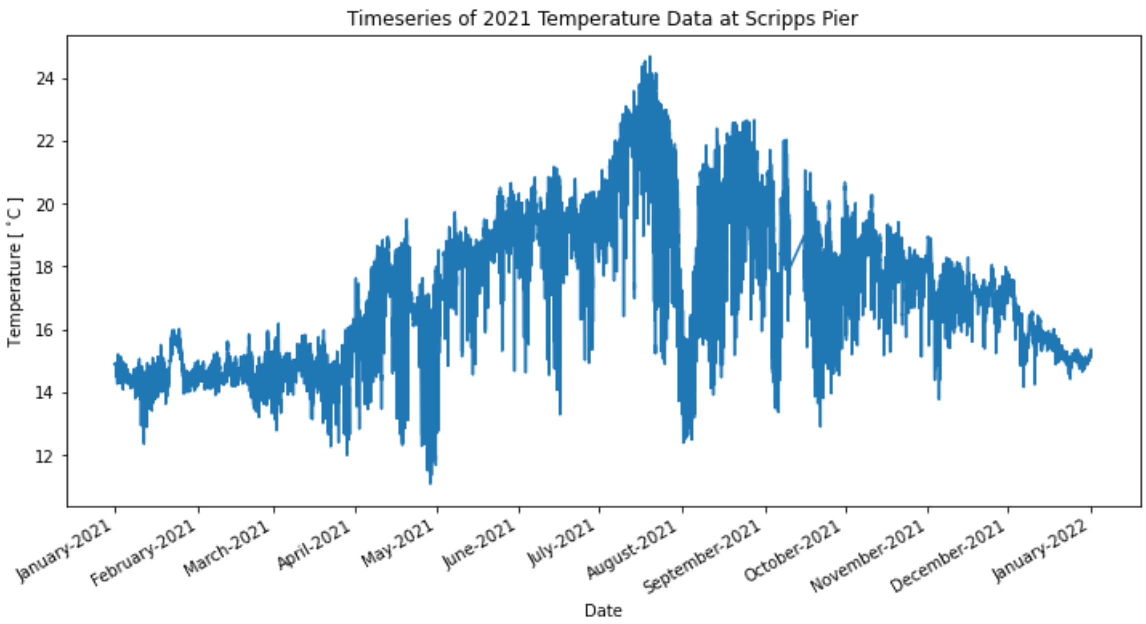
Q1: Download 2021 SST from Scripps Pier

In [4]:

```
url = 'http://thredds.sccoos.org/thredds/dodsC/autoss/scripps_pier-2021.n
nc = netCDF4.Dataset(url)

time = nc['time'][:]
temp = nc['temperature'][:]
sal = nc['salinity'][:]
p = nc['pressure'][:]
chl = nc['chlorophyll'][:]
station = nc['station'][:]
lon = nc['lon'][:]; lat = nc['lat'][:]
zeta = nc['depth'][:]

# time units = 'seconds since 1970-01-01 00:00:00 UTC'

start_time = dt.datetime(1970,1,1)
time_array = np.array(time.data)
dates = [start_time + dt.timedelta(seconds=float(tt)) for tt in time_arra
```

In [5]:

```
# part a: produce line plot of 2021 temps

fig,ax = plt.subplots(1,1,figsize=(12,6))
ax.plot(dates,temp) #,c=temp,cmap='Spectral_r')
ax.xaxis.set_major_formatter(mdates.DateFormatter('%B-%Y'))
ax.xaxis.set_major_locator(mdates.MonthLocator())
fig.autofmt_xdate()
ax.set(title='Timeseries of 2021 Temperature Data at Scripps Pier', xlabe
plt.show()
```



Observations from plot:

I notice the temperature variability is higher in the summer than in the winter. A seasonal trend is visible - with higher summer temperatures than winter temperatures. There is a sharp drop in August, which then returns to a bit less than the previous temperature state after about a week.

In [9]:

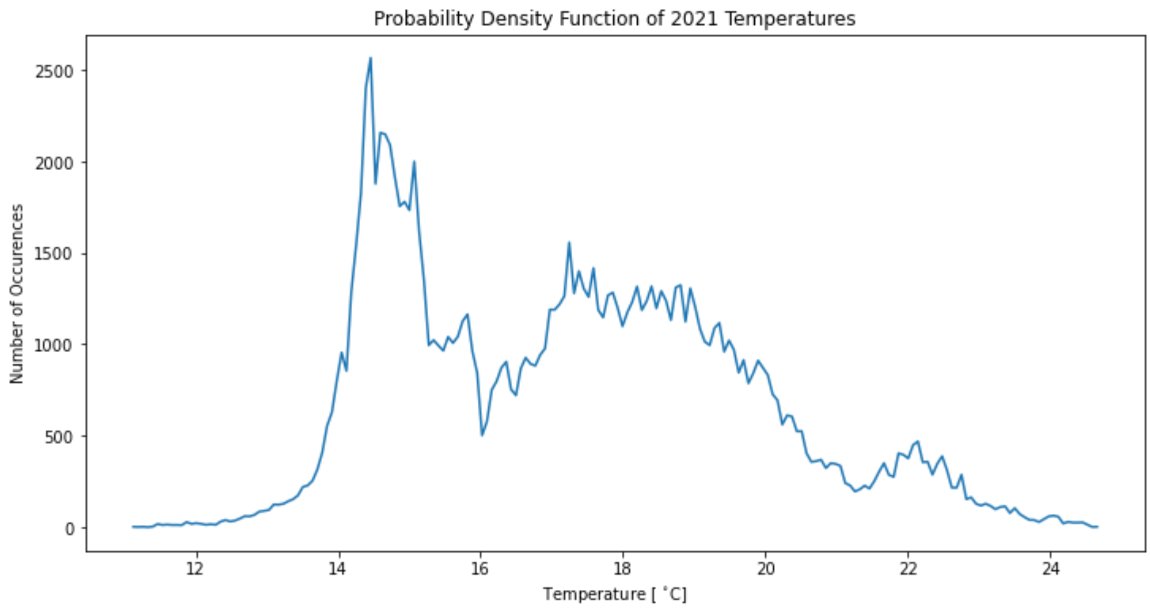
```
# part b: compute mean and stdev

temp_mean = np.nanmean(temp)
print(f'Temperature Mean of 2021 is: {temp_mean} deg C')
temp_std = np.std(temp)
print(f'Temperature Standard Deviation of 2021 is: {temp_std} deg C')
```

```
Temperature Mean of 2021 is: 17.273984909057617 deg C
Temperature Standard Deviation of 2021 is: 2.425363302230835 deg C
```

The temperature mean and standard deviation tell us about the average temperature throughout the year and the standard deviation tells us about the variability across temperature measurements.

In [10]:

```
# part c: empirical probability density function

[num_bin,bin_edges] = np.histogram(temp,bins=200)
mid_bins = (bin_edges[1:]+bin_edges[0:-1])/2

fig,ax = plt.subplots(1,1,figsize=(12,6))
ax.set_title('Probability Density Function of 2021 Temperatures')
ax.set_xlabel(r'Temperature [ $^{\circ} $C]'); ax.set_ylabel('Number of (
plt.plot(mid_bins,num_bin)
plt.show()
```



The PDF shown of the 2021 temperature dataset looks potentially like a trimodal distribution, more than anything we specifically discussed in class. There are 3 peaks, or 3 most frequent occurences, in the temperature observations, which are around 15 degrees, in the range of 18 degrees, and 22 degrees.

Q2: Extending the record

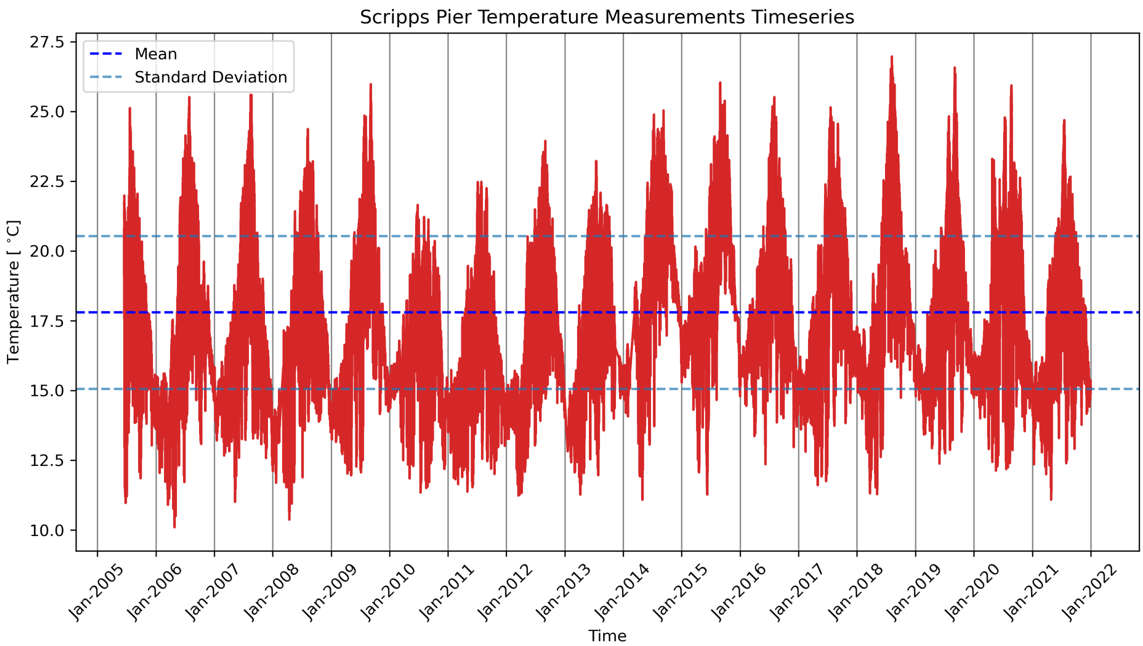
In [16]:

```
years = np.arange(2005,2022) # going from 2005 to 2021
year_string = [str(yy) for yy in years]

url_base = 'http://thredds.sccoos.org/thredds/dodsC/autoss/scripps_pier-
urls = [url_base+yy+'.nc' for yy in year_string]
time = np.array([])
temp = np.array([])
sal = np.array([])
p = np.array([])
chl = np.array([])
station = np.array([])
lon = np.array([]); lat = np.array([])
zeta = np.array([])

for n,fn in enumerate(urls):
    # read current file:
    nc = netCDF4.Dataset(fn)
    t_now = nc['time'][:]
    t_here = nc['temperature'][:]
    s_here = nc['salinity'][:]
    p_here = nc['pressure'][:]
    c_here = nc['chlorophyll'][:]
    s_here = nc['station'][:]
    lon_here = nc['lon'][:]; lat_here = nc['lat'][:]
    z_here = nc['depth'][:]

    # append to extended record
    time = np.append(time,t_now)
    temp = np.append(temp,t_here)
    sal = np.append(sal,s_here)
    p = np.append(p,p_here)
    chl = np.append(chl,c_here)
    station = np.append(station,s_here)
    lon = np.append(lon,lon_here); lat = np.append(lat,lat_here)
    zeta = np.append(zeta,z_here)

s0 = dt.datetime(1970,1,1)
dates = [s0+dt.timedelta(seconds=float(tt)) for tt in time.data]
SP = pd.DataFrame({'dates':np.array(dates),'temp':temp,'p':p,'chl':chl})
# information I couldn't add because size requirements: 'sal':sal, 'stat
```

In [17]:

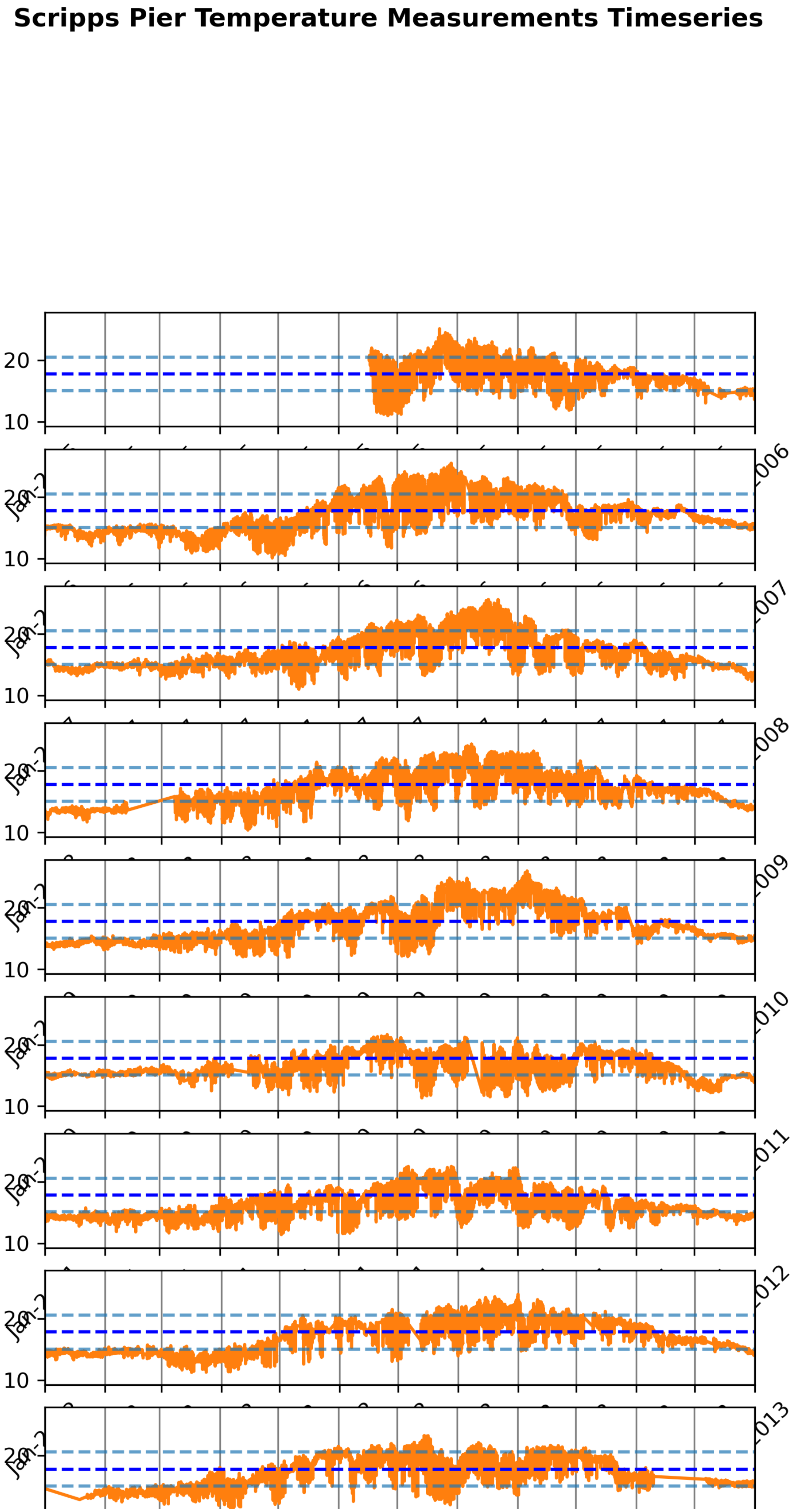
```
# Q2 part a: do the same thing
# compute mean and stdev - but excluding anaomalous data

outlier = np.nonzero(SP.temp>50)
SP.temp[SP.temp>50] = np.nan
temp[temp>50] = np.nan # also saving as temp because for some reason mat


temp_mean = np.nanmean(SP.temp)
temp_std = np.std(SP.temp)


fig,ax = plt.subplots(1,1,figsize=(12,6),dpi=300)
ax.plot(dates,temp,color='tab:red')
m = ax.axhline(y=temp_mean,linestyle='--',color='blue',label='Mean');
s1 = ax.axhline(y=temp_mean+temp_std,linestyle='--',color='tab:blue',alpl
s2 = ax.axhline(y=temp_mean-temp_std,linestyle='--',color='tab:blue',alpl
ax.xaxis.set_major_formatter(mdates.DateFormatter('%b-%Y')) # b is short
ax.xaxis.set_major_locator(mdates.YearLocator())
ax.tick_params(axis='x',rotation=45)
ax.set(title='Scripps Pier Temperature Measurements Timeseries',xlabel='
ax.grid(which='major',axis='x',color='tab:gray')
handles = ['Mean','Standard Deviation']
ax.legend([m,s2],handles,loc='best')
plt.show()
```

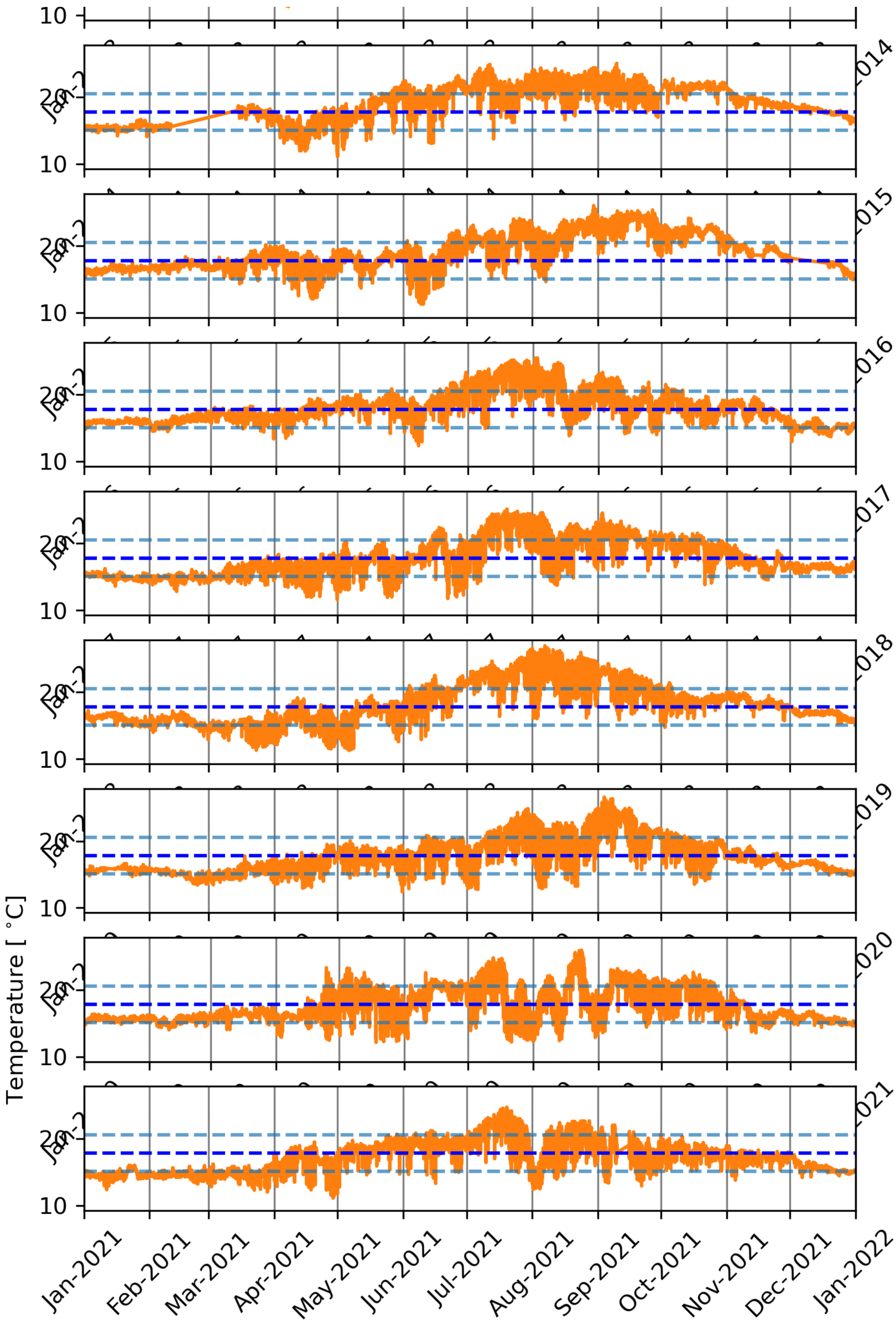
```
/tmp/ipykernel_90497/3649461809.py:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-do
cs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  SP.temp[SP.temp>50] = np.nan
```



In [24]:

```
num_yr = len(years);

fig,ax = plt.subplots(figsize=(6,20),dpi=300)
plt.suptitle('Scripps Pier Temperature Measurements Timeseries',fontweig
aa = 0;
for num,yr in enumerate(years):
    aa = aa + 1;
    ax = plt.subplot(num_yr,1,aa)
    ax.plot(dates,temp,color='tab:orange')
    ax.set_xlim([dt.datetime(yr,1,1), dt.datetime(yr+1,1,1)])
    m = ax.axhline(y=temp_mean,linestyle='--',color='blue',label='All-Ti
    s1 = ax.axhline(y=temp_mean+temp_std,linestyle='--',color='tab:blue'
    s2 = ax.axhline(y=temp_mean-temp_std,linestyle='--',color='tab:blue'
    ax.xaxis.set_major_formatter(mdates.DateFormatter('%b-%Y')) # b is s
    ax.xaxis.set_major_locator(mdates.MonthLocator())
    ax.tick_params(axis='x',rotation=45)
    if aa == num_yr-1:
        ax.set(xlabel='Time',ylabel=r'Temperature [ $ ^{\circ} $C]')
    ax.grid(which='major',axis='x',color='tab:gray')
    handles = ['All-Time Mean','Standard Deviation']
    if aa == 0:
        ax.legend([m,s2],handles,loc='best')

plt.show()
```

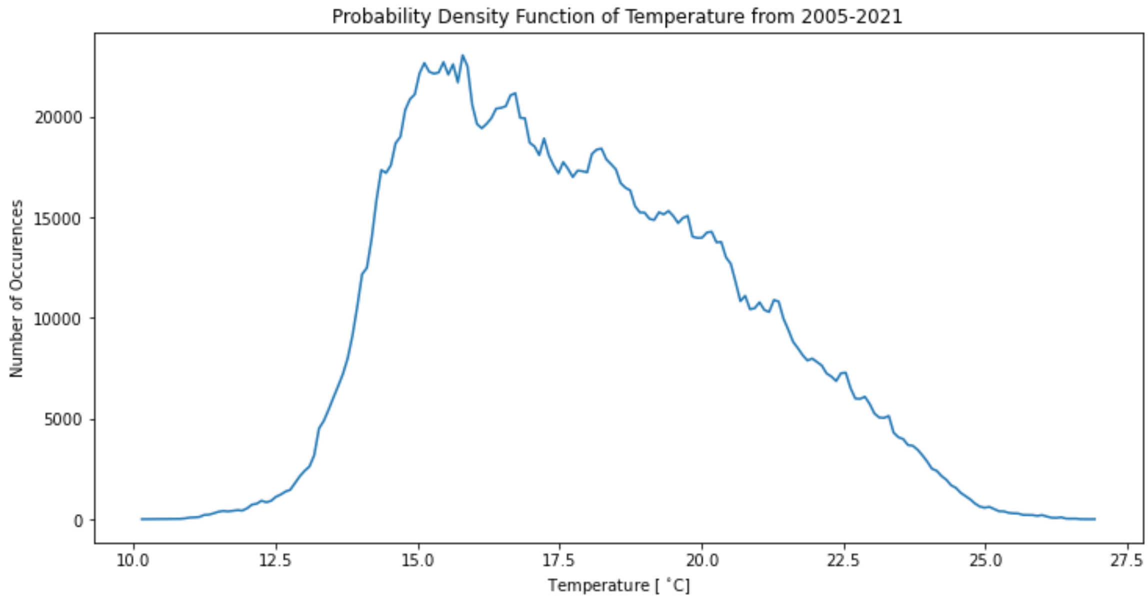

Scripps Pier Temperature Measurements Timeseries
20
10
2006
2007
2008
2009
2010
2011
2012
2013



Q's: What do you observe in these results? In what ways are the 2021 results different from the 2005-2021 results? Is 2021 unusual? Is the sharp temperature change in August 2016 unusual?

2021 doesn't look especially unusual. A few other years have a drop in temperature during August/around August or later. The overall climatology looks pretty similar, where there is the most overall climatology looks pretty similar. where there is the most

In [15]:
```
# part c: empirical probability density function

[num_bin,bin_edges] = np.histogram(SP.temp[~np.isnan(SP.temp)],bins=200)

mid_bins = (bin_edges[1:]+bin_edges[0:-1])/2

fig,ax = plt.subplots(1,1,figsize=(12,6))
plt.plot(mid_bins,num_bin)
ax.set_title('Probability Density Function of Temperature from 2005-2021
ax.set_xlabel(r'Temperature [ $^{\circ} $C]'); ax.set_ylabel('Number of (
plt.show()
```



The PDF of the 2005-2021 data looks more like a Gaussian distribution than the 2021 dataset, but it looks like there is some skew to the data - where the higher temperatures fall off more slowly versus the colder temperatures fall off more steeply.