Exercise 2 ATM325

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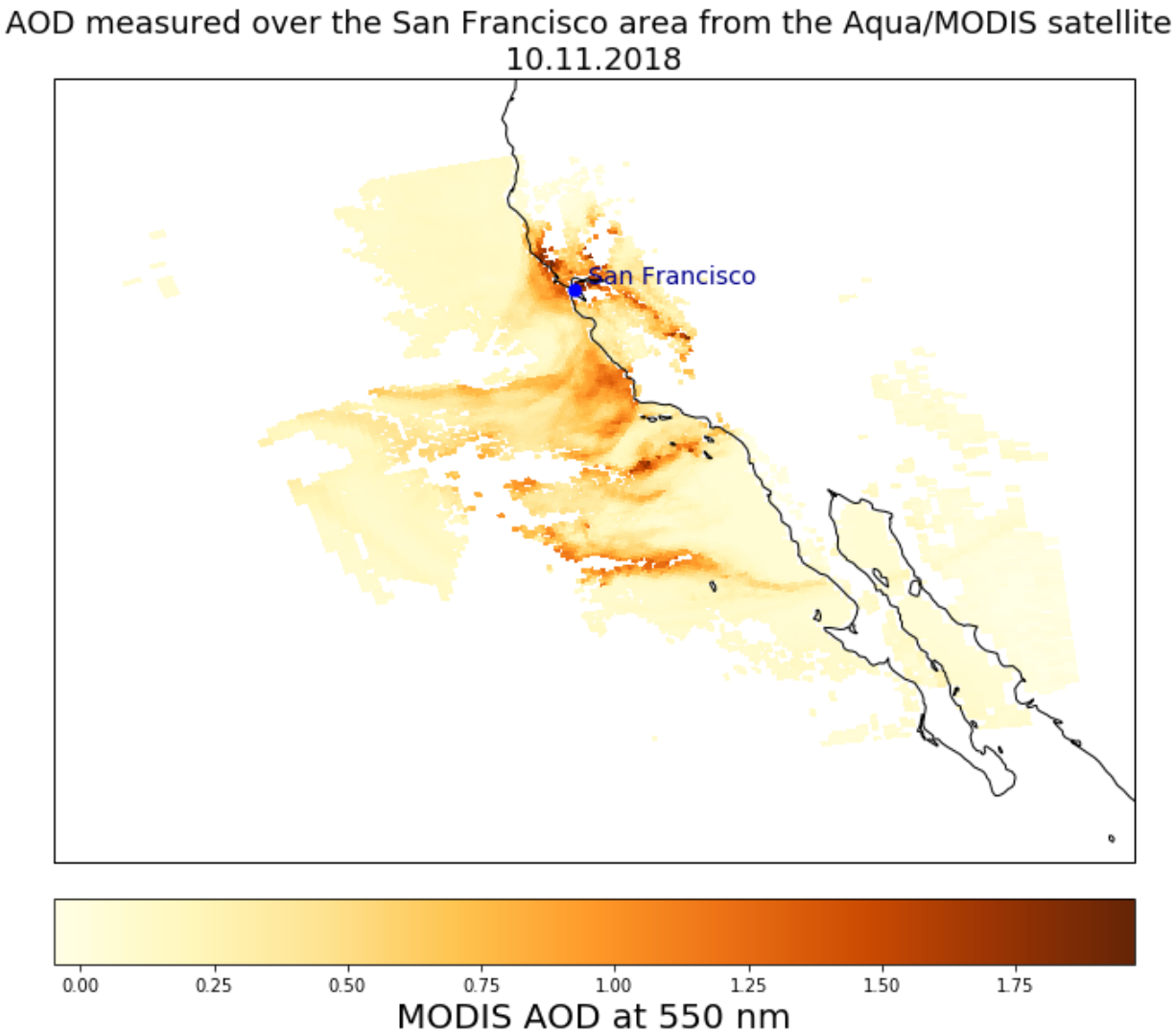
In [1]:
```
# %matplotlib notebook
# Importing libraries
import xarray as xr
import numpy as np
import matplotlib.pyplot as plt
import cartopy as cr
import cartopy.crs as ccrs
from pyhdf import SD
import matplotlib as mpl
import cartopy.feature as cfeature
from cartopy.io.img_tiles import Stamen
# %matplotlib inline
import warnings
warnings.filterwarnings('ignore')
mpl.rc('axes', labelsize=20)
```

1. Modis AOD

In [2]:
```
FileName = 'MYD04_L2.A2018314.2115.061.2018315171148.hdf'
SDSName = 'Optical_Depth_Land_And_Ocean'
dataset = SD.SD(FileName)

#Get lon lat
lat = dataset.select('Latitude')
lon = dataset.select('Longitude')

#select data product
sds = dataset.select(SDSName)
attr = sds.attributes()
#Get Scale factor
scale_factor = attr['scale_factor']
#Get fill values
fv = attr['_FillValue']

# Turn fill values to Nan
data = sds.get()
data = data.astype(float)
data[data == fv] = np.nan

data = np.ma.masked_array(data, np.isnan(data))

# Multiply scale factor
data =data*scale_factor
```

In [3]:
```
fig = plt.figure(figsize=(10, 12), constrained_layout=True)
ax = plt.axes(projection=ccrs.PlateCarree())
# tiler = Stamen('terrain-background')
plt.pcolormesh(lon[:],lat[:], data, cmap ='YlOrBr',
               transform=ccrs.PlateCarree())
ax.coastlines(resolution='50m', color='black', linewidth=1)
# ax.add_image(tiler, 6)
plt.colorbar(orientation='horizontal', label='MODIS AOD at 550 nm');
ax.plot(-122.419, 37.775 ,'bo', markersize=7, transform=ccrs.PlateCarree(), color = 'b
lue')
ax.text(-122, 38, 'San Francisco', transform=ccrs.PlateCarree(), fontsize = 14, color
='darkblue');
plt.title('AOD measured over the San Francisco area from the Aqua/MODIS satellite \n'
          '10.11.2018', fontsize=18)


extent =  ax.get_extent()
```



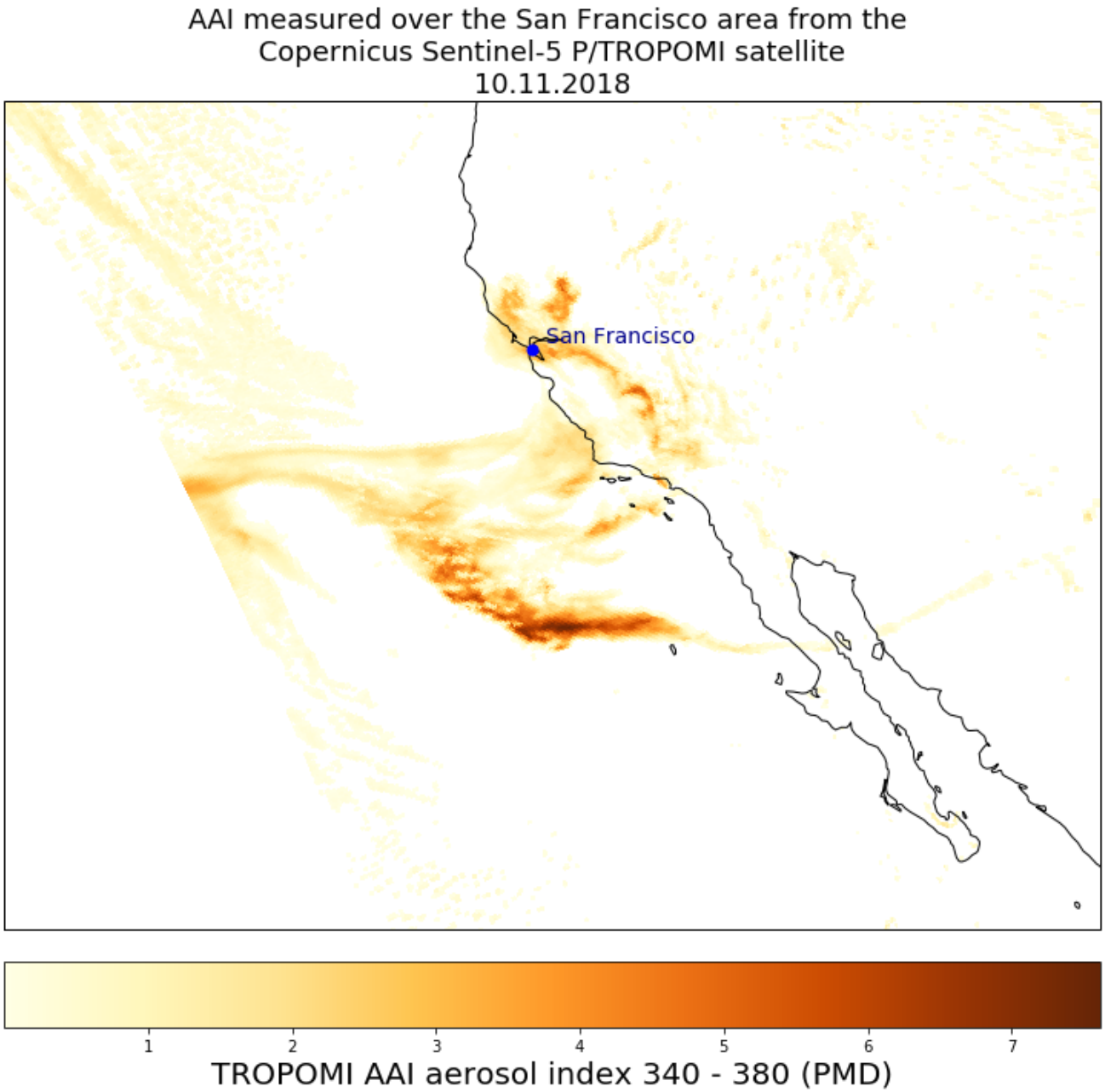
The figure show AOD over the San Francisco area on November 10th 2018. The highest values of AOD are concentrated the around the city, which are most likely due to air pollution. There is also quite high values of AOD of the ocean which is smoke from wildfires. The pixels without any observed AOD is most likely clouds masked by the cloud removal algorimth or parts of the smoke plume which is miss identifyied. The larger areas with out any AOD might be areas which are so clear that they fall outside the instruments dectection range

TROPOMI AAI

In [4]:

```
fileName = 'S5P_OFFL_L2__AER_AI_20181110T195023_20181110T213153_05582_01_010200_20181116T191647.nc'
dset = xr.open_dataset(fileName, engine='netcdf4', group="/PRODUCT")

lons = dset['longitude'][0,:,:]
lats = dset['latitude'][0,:,:]

aai = dset['aerosol_index_340_380'][0,:,:]
qa = dset['qa_value'][0,:,:]
#Remove bad pixels
aai_qa = aai.where(qa >= 0.5)
#Remove negative values
aai_qa = aai_qa.where(aai_qa >= 0)
```

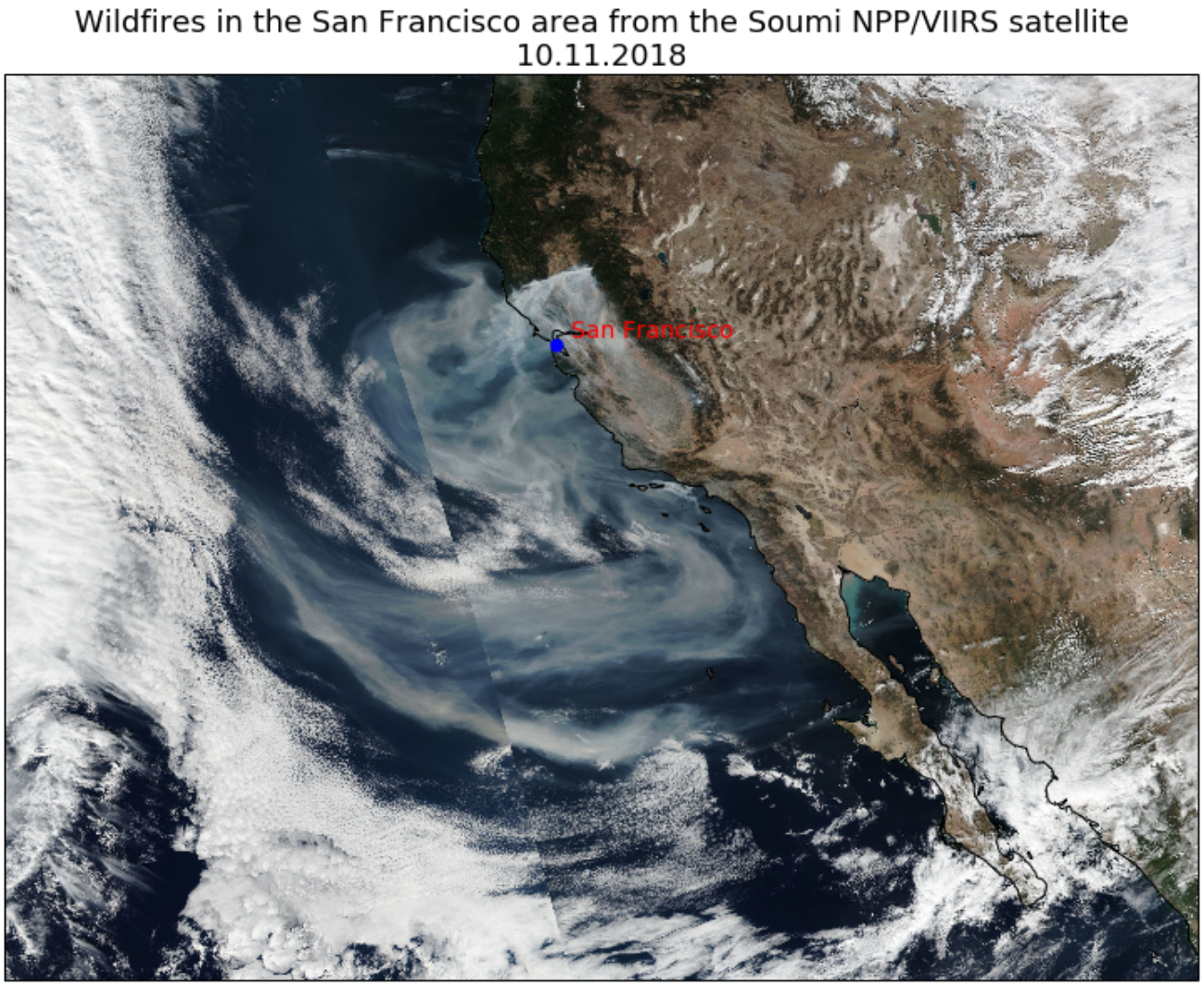
In [5]:
```
fig = plt.figure(figsize=(10, 12), constrained_layout=True)
ax = plt.axes(projection=ccrs.PlateCarree())

plt.pcolormesh(lons[:],lats[:], aai_qa, cmap ='YlOrBr',
               transform=ccrs.PlateCarree())
ax.set_extent(extent)
ax.coastlines(resolution='50m', color='black', linewidth=1)
plt.title('AAI measured over the San Francisco area from the \n Copernicus Sentinel-5
 P/TROPOMI satellite \n'
          '10.11.2018', fontsize=18)
plt.colorbar(orientation='horizontal', label='TROPOMI AAI aerosol index 340 - 380 (PM
D)');
ax.plot(-122.419, 37.775 ,'bo', markersize=7, transform=ccrs.PlateCarree(), color = 'b
lue')
ax.text(-122, 38, 'San Francisco', transform=ccrs.PlateCarree(), fontsize = 14,
        color ='darkblue');
```



The AAI measurment from TROPOMI is able to capture the densest part of smoke plume over the ocean, which in AOD oberservation from MODIS is miss identified as a cloud and removed. On the otherhand the TROPOMI AAI show relative low values of AAI over the city compared to the AOD from MODIS. This might be because the aerosols due air pollution from the city is not as good absorbers as the aerosols released from the wildfire.

True color image VIIRS

In [6]:
```
fig = plt.figure(figsize=(10, 12), constrained_layout=True)
fname = 'VIIRS10_11_2018.png'
#20.953125000000007,-137.00390625,44.92968750000001,-105.3984375
img_extent = (-137.00390625, -105.3984375, 20.953125000000007, 44.92968750000001)
img = plt.imread(fname)

ax = plt.axes(projection=ccrs.PlateCarree())
plt.title('Wildfires in the San Francisco area from the Soumi NPP/VIIRS satellite\n'
          '10.11.2018', fontsize=18)

# set a margin around the data
ax.set_xmargin(0.05)
ax.set_ymargin(0.10)
ax.imshow(img, origin='upper', extent=img_extent, transform=ccrs.PlateCarree())
ax.coastlines(resolution='50m', color='black', linewidth=1)
ax.plot(-122.419, 37.775 ,'bo', markersize=7, transform=ccrs.PlateCarree(), color = 'b
lue')
ax.text(-122, 38, 'San Francisco', transform=ccrs.PlateCarree(), fontsize = 14,
        color ='red');
```



The true color image from worldview, makes it clear that large AOD and AAI over the ocean are due to smoke from the wildfires.