

```

fig.canvas.print_figure(bytes_io, **kw)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backend_bases.py", line
2049, in print_figure
    **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backends\backend_agg.py",
line 510, in print_png
    FigureCanvasAgg.draw(self)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backends\backend_agg.py",
line 402, in draw
    self.figure.draw(self.renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\figure.py", line 1649, in
draw
    renderer, self, artists, self.suppressComposite)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\image.py", line 138, in
_draw_list_compositing_images
    a.draw(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axes\_base.py", line 2628,
in draw
    mimage._draw_list_compositing_images(renderer, self, artists)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\image.py", line 138, in
_draw_list_compositing_images
    a.draw(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 1185, in draw
    ticks_to_draw = self._update_ticks(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 1023, in
_update_ticks
    tick_tups = list(self.iter_ticks()) # iter_ticks calls the locator

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 967, in
iter_ticks
    majorLocs = self.major.locator()

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1230, in
__call__

```

```
self.refresh()
```

```
File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1250, in refresh
```

```
dmin, dmax = self.viewlim_to_dt()
```

```
File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1001, in viewlim_to_dt  
.format(vmin))
```

ValueError: view limit minimum -36818.79947916667 is less than 1 and is an invalid Matplotlib date value. This often happens if you pass a non-datetime value to an axis that has datetime units

<Figure size 1584x720 with 1 Axes>

In [26]:

```
In [26]: def arima_model(ts, order):  
...:     # fit model  
...:     ts = do_train  
...:     model = ARIMA(ts, order=(1,0,1)) # (ARMA) = (p,d,q)  
...:     model_fit = model.fit(dispatch=0)  
...:  
...:     # predict  
...:     forecast = model_fit.predict(start=0, end=1920)  
...:  
...:     # visualization  
...:     plt.figure(figsize=(22,10))  
...:     plt.plot(do_train,label = "original")  
...:     plt.plot(forecast,label = "predicted")  
...:     plt.title("Turbidity Time Series Forecast")  
...:     plt.xlabel("Date")  
...:     plt.ylabel("Turbidity(FNU)")  
...:     plt.legend()  
...:     plt.show()
```

In [27]: arima_model(do,(1,0,1))

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:225:

ValueWarning: A date index has been provided, but it has no associated frequency information and so will be ignored when e.g. forecasting.

' ignored when e.g. forecasting.', ValueWarning)

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:531:

ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

ValueWarning)

Traceback (most recent call last):

```
File "C:\Users\admin\Anaconda3\lib\site-packages\IPython\core\formatters.py", line 341,  
in __call__  
    return printer(obj)
```

```
File "C:\Users\admin\Anaconda3\lib\site-packages\IPython\core\pylabtools.py", line 244,  
in <lambda>  
    png_formatter.for_type(Figure, lambda fig: print_figure(fig, 'png', **kwargs))
```

```

File "C:\Users\admin\Anaconda3\lib\site-packages\IPython\core\pylabtools.py", line 128,
in print_figure
    fig.canvas.print_figure(bytes_io, **kw)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backend_bases.py", line
2049, in print_figure
    **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backends\backend_agg.py",
line 510, in print_png
    FigureCanvasAgg.draw(self)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backends\backend_agg.py",
line 402, in draw
    self.figure.draw(self.renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\figure.py", line 1649, in
draw
    renderer, self, artists, self.suppressComposite)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\image.py", line 138, in
_draw_list_compositing_images
    a.draw(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axes\_base.py", line 2628,
in draw
    mimage._draw_list_compositing_images(renderer, self, artists)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\image.py", line 138, in
_draw_list_compositing_images
    a.draw(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 1185, in draw
    ticks_to_draw = self._update_ticks(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 1023, in
_update_ticks
    tick_tups = list(self.iter_ticks()) # iter_ticks calls the locator

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 967, in
iter_ticks
    majorLocs = self.major.locator()

```

```
File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1230, in
__call__
    self.refresh()
```

```
File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1250, in
refresh
    dmin, dmax = self.viewlim_to_dt()
```

```
File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1001, in
viewlim_to_dt
    .format(vmin))
```

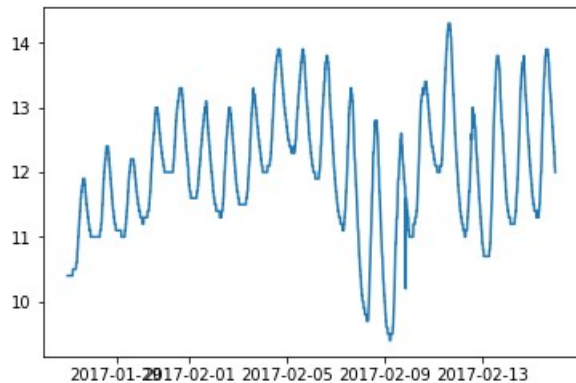
ValueError: view limit minimum -36818.79947916667 is less than 1 and is an invalid Matplotlib date value. This often happens if you pass a non-datetime value to an axis that has datetime units

<Figure size 1584x720 with 1 Axes>

In [28]:

```
In [28]: plt.plot(do_train,label = "original")
```

```
Out[28]: [matplotlib.lines.Line2D at 0x16fb5245208]
```



```
In [29]: plt.plot(forecast,label = "predicted")
```

Traceback (most recent call last):

```
File "<ipython-input-29-fdda86083190>", line 1, in <module>
    plt.plot(forecast,label = "predicted")
```

NameError: name 'forecast' is not defined

In [30]:

```
In [30]: ts = do_train
```

```
....: model = ARIMA(ts, order=(1,0,1)) # (ARMA) = (p,d,q)
```

```
....: model_fit = model.fit(dispatch=0)
```

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:225:

ValueWarning: A date index has been provided, but it has no associated frequency information and so will be ignored when e.g. forecasting.

' ignored when e.g. forecasting.', ValueWarning)

```

In [31]: forecast = model_fit.predict(start=0, end=1920)
...:
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:531:
ValueWarning: No supported index is available. Prediction results will be given with an
integer index beginning at `start`.
ValueWarning)

In [32]: plt.figure(figsize=(22,10))
...: plt.plot(do_train,label = "original")
...: plt.plot(forecast,label = "predicted")
...: plt.title("Turbidity Time Series Forecast")
Out[32]: Text(0.5, 1.0, 'Turbidity Time Series Forecast')Error in callback <function
install_repl_displayhook.<locals>.post_execute at 0x0000016FB2375158> (for post_execute):
Traceback (most recent call last):

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\pyplot.py", line 109, in
post_execute
    draw_all()

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\_pylab_helpers.py", line
132, in draw_all
    f_mgr.canvas.draw_idle()

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backend_bases.py", line
1899, in draw_idle
    self.draw(*args, **kwargs)

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backends\backend_agg.py",
line 402, in draw
    self.figure.draw(self.renderer)

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\figure.py", line 1649, in
draw
    renderer, self, artists, self.suppressComposite)

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\image.py", line 138, in
_draw_list_compositing_images
    a.draw(renderer)

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axes\_base.py", line 2628,
in draw
    mimage._draw_list_compositing_images(renderer, self, artists)

  File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\image.py", line 138, in
_draw_list_compositing_images
    a.draw(renderer)

```

```

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 1185, in draw
    ticks_to_draw = self._update_ticks(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 1023, in
_update_ticks
    tick_tups = list(self.iter_ticks()) # iter_ticks calls the locator

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 967, in
iter_ticks
    majorLocs = self.major.locator()

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1230, in
__call__
    self.refresh()

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1250, in
refresh
    dmin, dmax = self.viewlim_to_dt()

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1001, in
viewlim_to_dt
    .format(vmin))

```

ValueError: view limit minimum -36818.79947916667 is less than 1 and is an invalid Matplotlib date value. This often happens if you pass a non-datetime value to an axis that has datetime units

Traceback (most recent call last):

```

File "C:\Users\admin\Anaconda3\lib\site-packages\IPython\core\formatters.py", line 341,
in __call__
    return printer(obj)

File "C:\Users\admin\Anaconda3\lib\site-packages\IPython\core\pylabtools.py", line 244,
in <lambda>
    png_formatter.for_type(Figure, lambda fig: print_figure(fig, 'png', **kwargs))

File "C:\Users\admin\Anaconda3\lib\site-packages\IPython\core\pylabtools.py", line 128,
in print_figure
    fig.canvas.print_figure(bytes_io, **kw)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backend_bases.py", line
2049, in print_figure
    **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backends\backend_agg.py",
line 510, in print_png
    FigureCanvasAgg.draw(self)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\backends\backend_agg.py",
line 402, in draw

```

```

self.figure.draw(self.renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\figure.py", line 1649, in
draw
    renderer, self, artists, self.suppressComposite)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\image.py", line 138, in
_draw_list_compositing_images
    a.draw(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axes\_base.py", line 2628,
in draw
    mimage._draw_list_compositing_images(renderer, self, artists)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\image.py", line 138, in
_draw_list_compositing_images
    a.draw(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\artist.py", line 50, in
draw_wrapper
    return draw(artist, renderer, *args, **kwargs)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 1185, in draw
    ticks_to_draw = self._update_ticks(renderer)

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 1023, in
_update_ticks
    tick_tups = list(self.iter_ticks()) # iter_ticks calls the locator

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\axis.py", line 967, in
iter_ticks
    majorLocs = self.major.locator()

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1230, in
__call__
    self.refresh()

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1250, in
refresh
    dmin, dmax = self.viewlim_to_dt()

File "C:\Users\admin\Anaconda3\lib\site-packages\matplotlib\dates.py", line 1001, in
viewlim_to_dt
    .format(vmin))

```

ValueError: view limit minimum -36818.79947916667 is less than 1 and is an invalid Matplotlib date value. This often happens if you pass a non-datetime value to an axis that

has datetime units

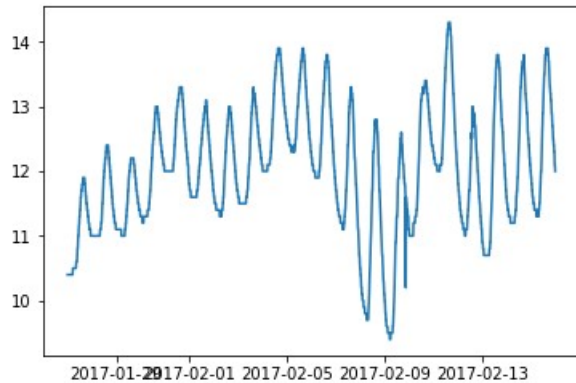
<Figure size 1584x720 with 1 Axes>

In [33]:

In [33]:

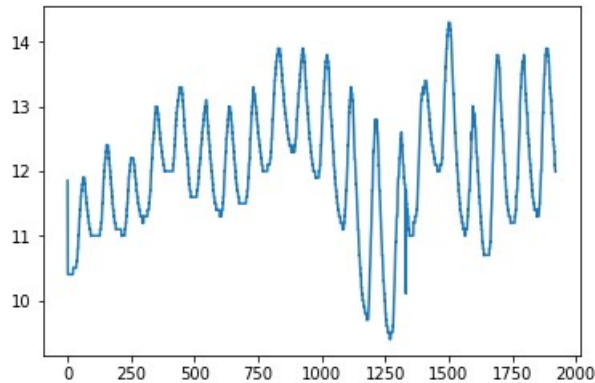
In [33]: plt.plot(do_train, label = "original")

Out[33]: [matplotlib.lines.Line2D at 0x16fb59fb438]



In [34]: plt.plot(forecast, label = "predicted")

Out[34]: [matplotlib.lines.Line2D at 0x16fb5a6a4e0]



In [35]: forecast = model_fit.predict(start=1920, end=5171)

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:531:
ValueWarning: No supported index is available. Prediction results will be given with an
integer index beginning at `start`.

ValueWarning)

Traceback (most recent call last):

File "<ipython-input-35-8a7a9104316c>", line 1, in <module>
forecast = model_fit.predict(start=1920, end=5171)

File "C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\wrapper.py", line 95,
in wrapper

obj = data.wrap_output(func(results, *args, **kwargs), how)

File "C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\data.py", line 416, in
wrap_output


```
return self.attach_dates(obj)
```

```
File "C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\data.py", line 560, in  
attach_dates  
    return Series(squeezed, index=self.predict_dates)
```

```
File "C:\Users\admin\Anaconda3\lib\site-packages\pandas\core\series.py", line 262, in  
__init__  
    .format(val=len(data), ind=len(index)))
```

ValueError: Length of passed values is 3253, index implies 3252

In [36]:

```
In [36]: forecast = model_fit.predict(start=1919, end=5171)
```

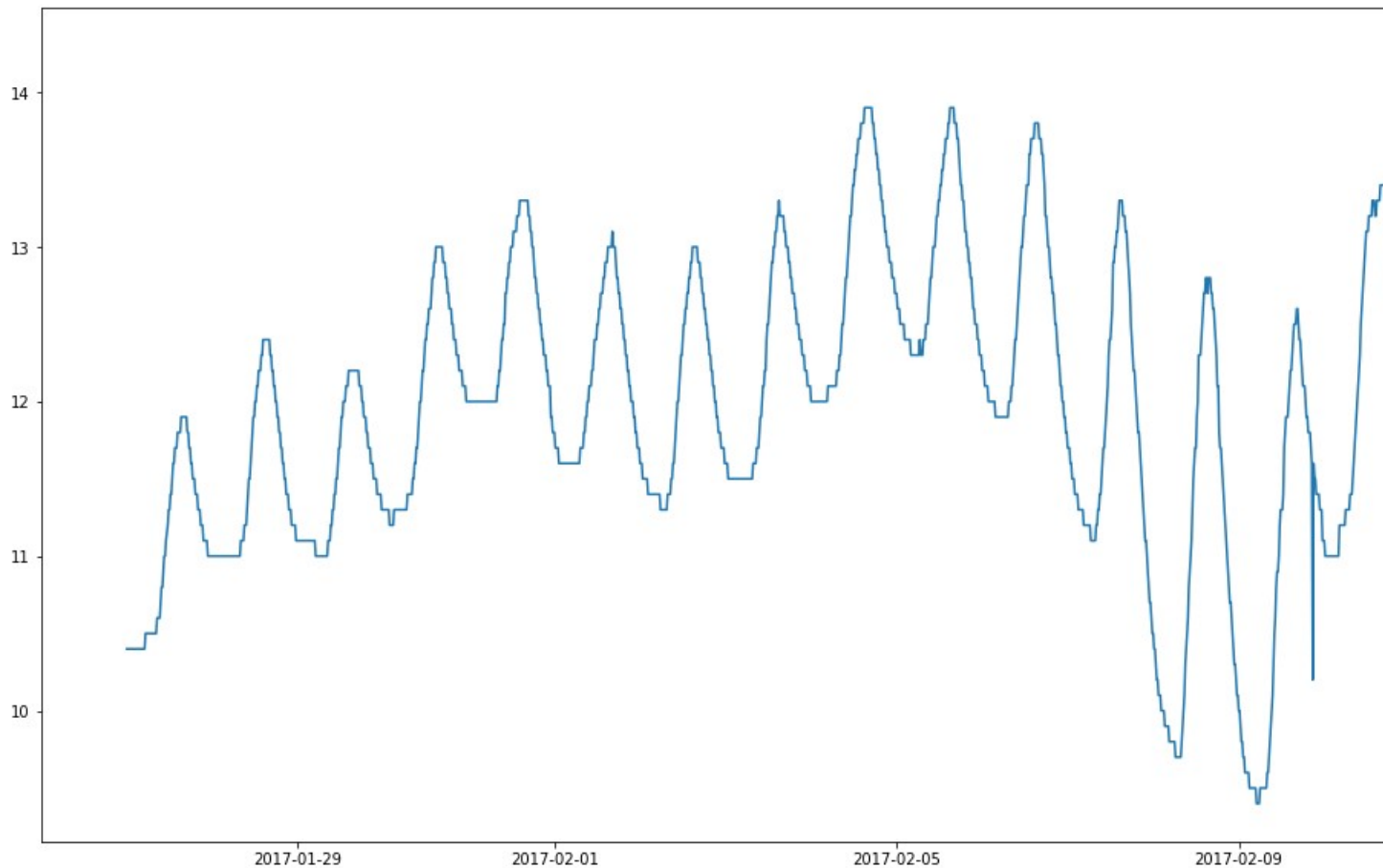
```
....:
```

```
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:531:  
ValueWarning: No supported index is available. Prediction results will be given with an  
integer index beginning at `start`.  
ValueWarning)
```

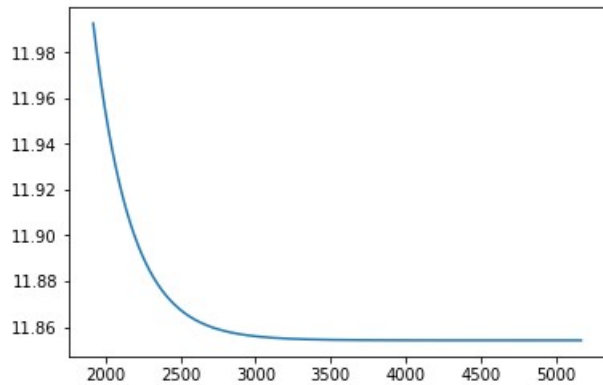
```
In [37]: plt.figure(figsize=(22,10))
```

```
....: plt.plot(do_train,label = "original")
```

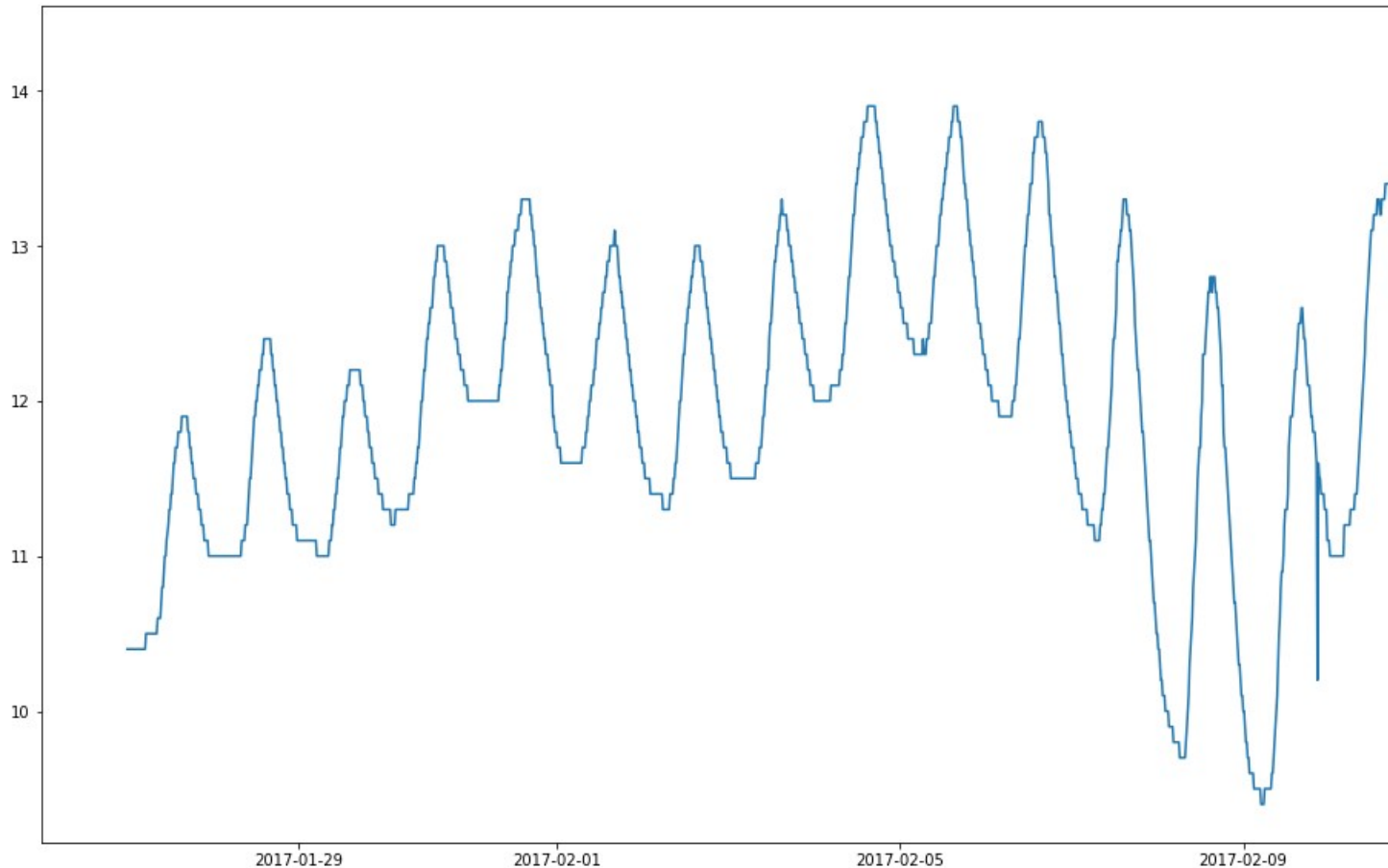
```
Out[37]: [matplotlib.lines.Line2D at 0x16fb5a944e0>]
```



```
In [38]: plt.plot(forecast,label = "predicted")
Out[38]: [matplotlib.lines.Line2D at 0x16fb5b779b0]
```

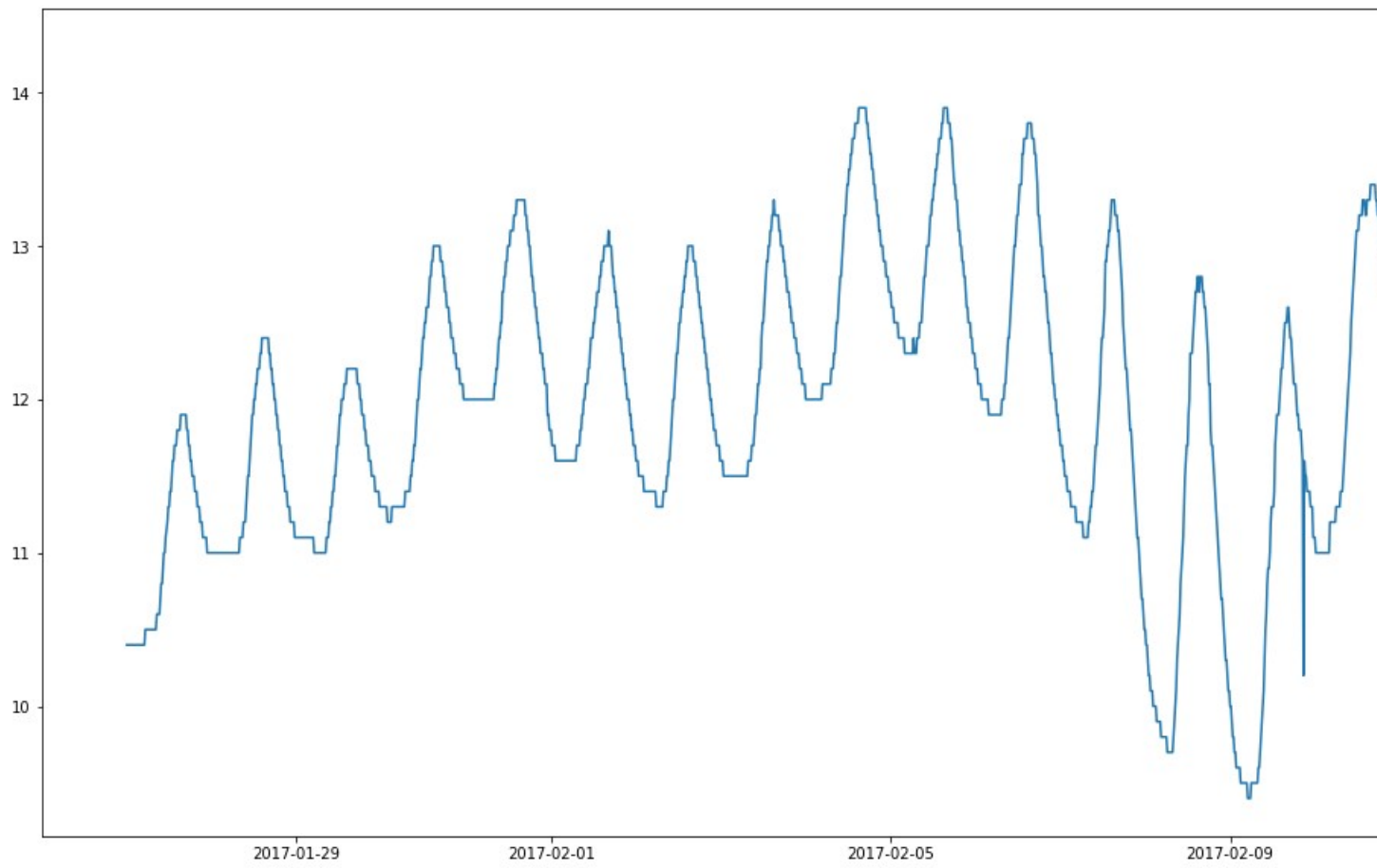


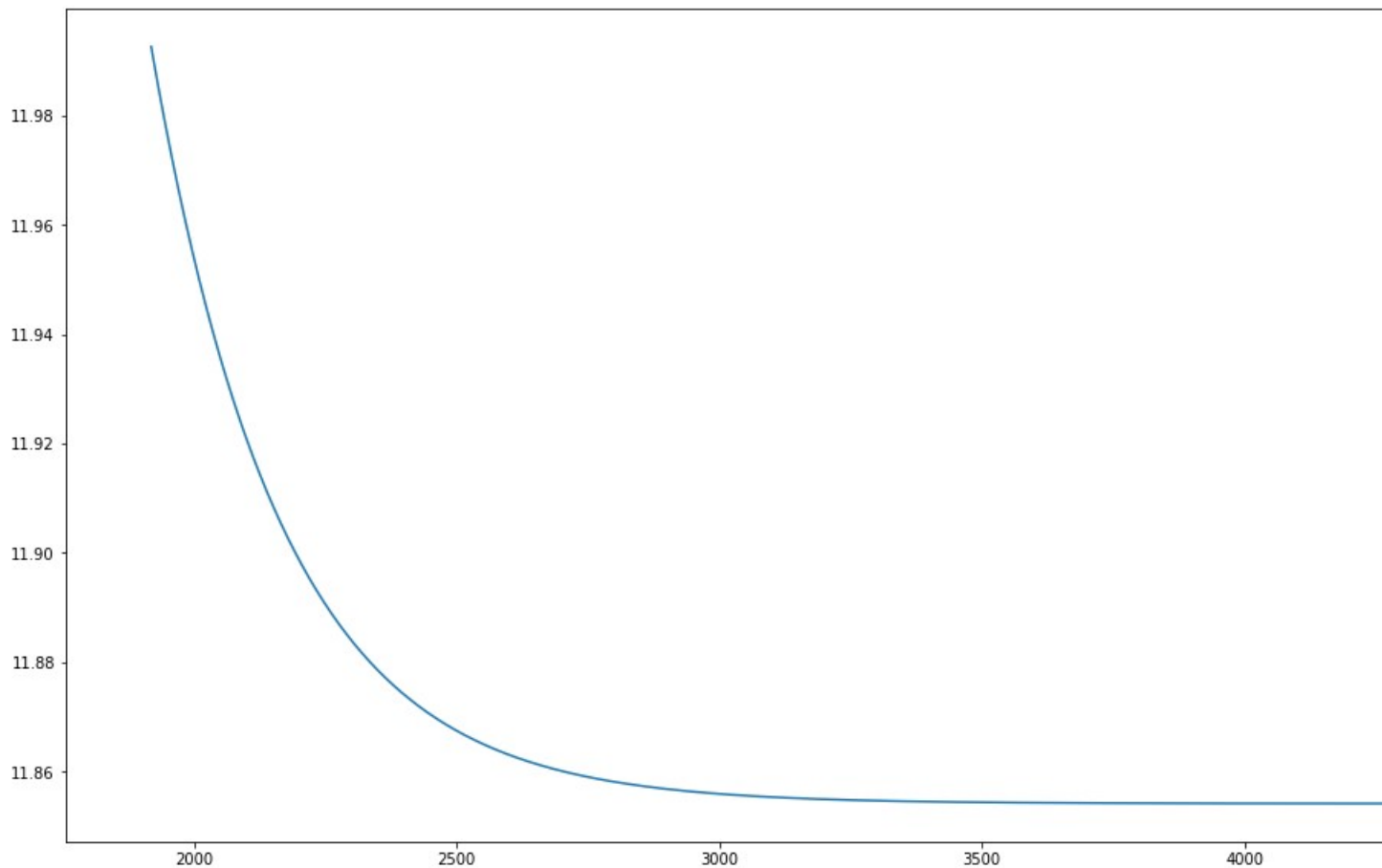
```
In [39]: plt.figure(figsize=(22,10))
...: plt.plot(do_train,label = "original")
...: plt.figure(figsize=(22,10))
Out[39]: <Figure size 1584x720 with 0 Axes>
```



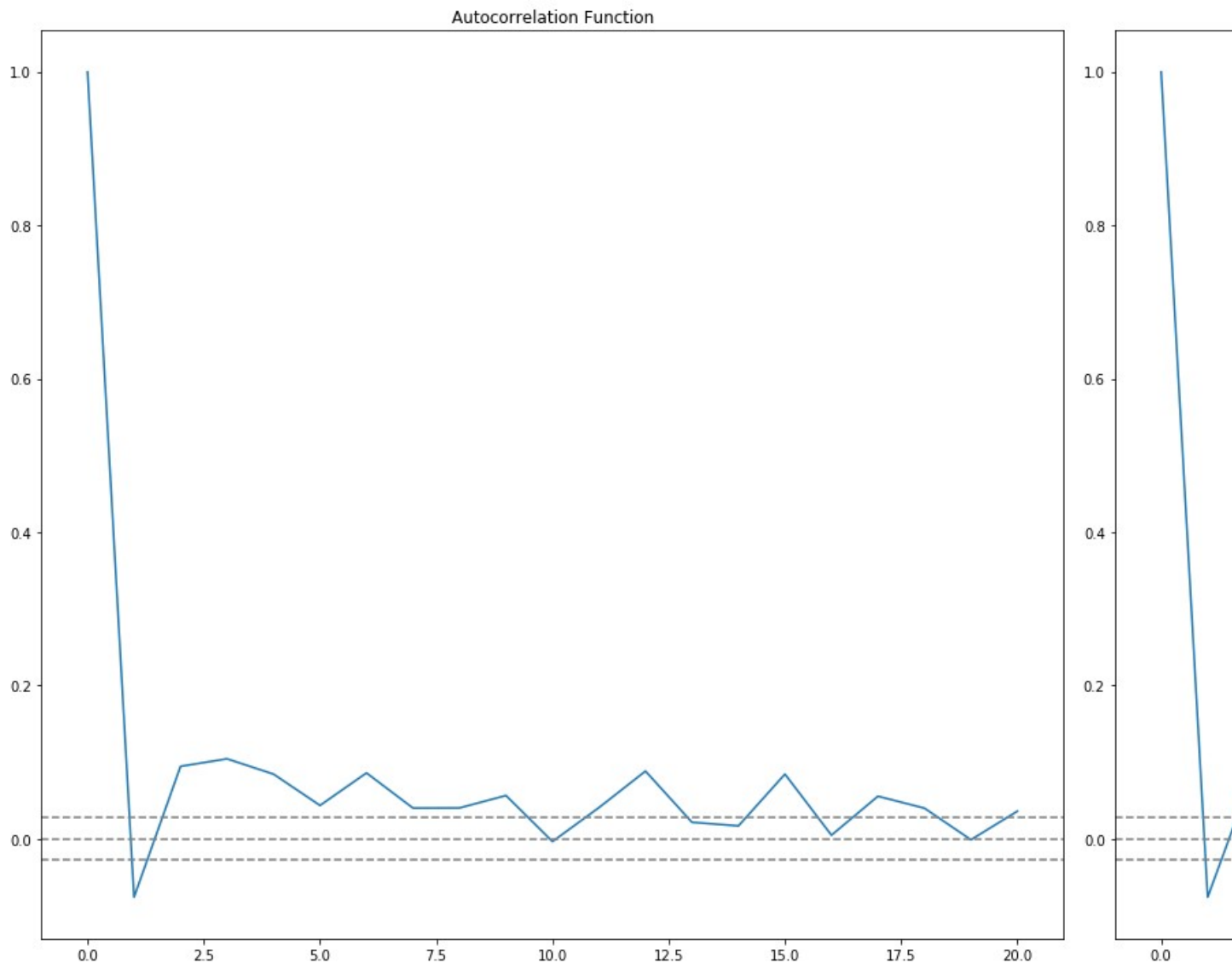
<Figure size 1584x720 with 0 Axes>

```
In [40]: plt.figure(figsize=(22,10))
...: plt.plot(do_train,label = "original")
...: plt.figure(figsize=(22,10))
...: plt.plot(forecast,label = "predicted")
Out[40]: [matplotlib.lines.Line2D at 0x16fb5bceef0]
```





```
In [41]: dataset = sc
...: ts_diff = dataset - dataset.shift()
...: ts_diff.dropna(inplace=True)
...: lag_acf = acf(ts_diff, nlags=20)
...: lag_pacf = pacf(ts_diff, nlags=20, method='ols')
...:
...: # ACF
...: plt.figure(figsize=(22,10))
...:
...: plt.subplot(121)
...: plt.plot(lag_acf)
...: plt.axhline(y=0,linestyle='--',color='gray')
...: plt.axhline(y=-1.96/np.sqrt(len(ts_diff)),linestyle='--',color='gray')
...: plt.axhline(y=1.96/np.sqrt(len(ts_diff)),linestyle='--',color='gray')
...: plt.title('Autocorrelation Function')
...:
...: # PACF
...: plt.subplot(122)
...: plt.plot(lag_pacf)
...: plt.axhline(y=0,linestyle='--',color='gray')
...: plt.axhline(y=-1.96/np.sqrt(len(ts_diff)),linestyle='--',color='gray')
...: plt.axhline(y=1.96/np.sqrt(len(ts_diff)),linestyle='--',color='gray')
...: plt.title('Partial Autocorrelation Function')
...: plt.tight_layout()
```



```
In [42]: sc_train,sc_test = tts(sc_,test_size = test_size, random_state=0, shuffle=False)
...:
```

Traceback (most recent call last):

```
File "<ipython-input-42-6a13cc4eee84>", line 1, in <module>
    sc_train,sc_test = tts(sc_,test_size = test_size, random_state=0, shuffle=False)
```

NameError: name 'sc_' is not defined

```
In [43]:
```

```
In [43]: sc_train,sc_test = tts(sc,test_size = test_size, random_state=0, shuffle=False)
...:
```

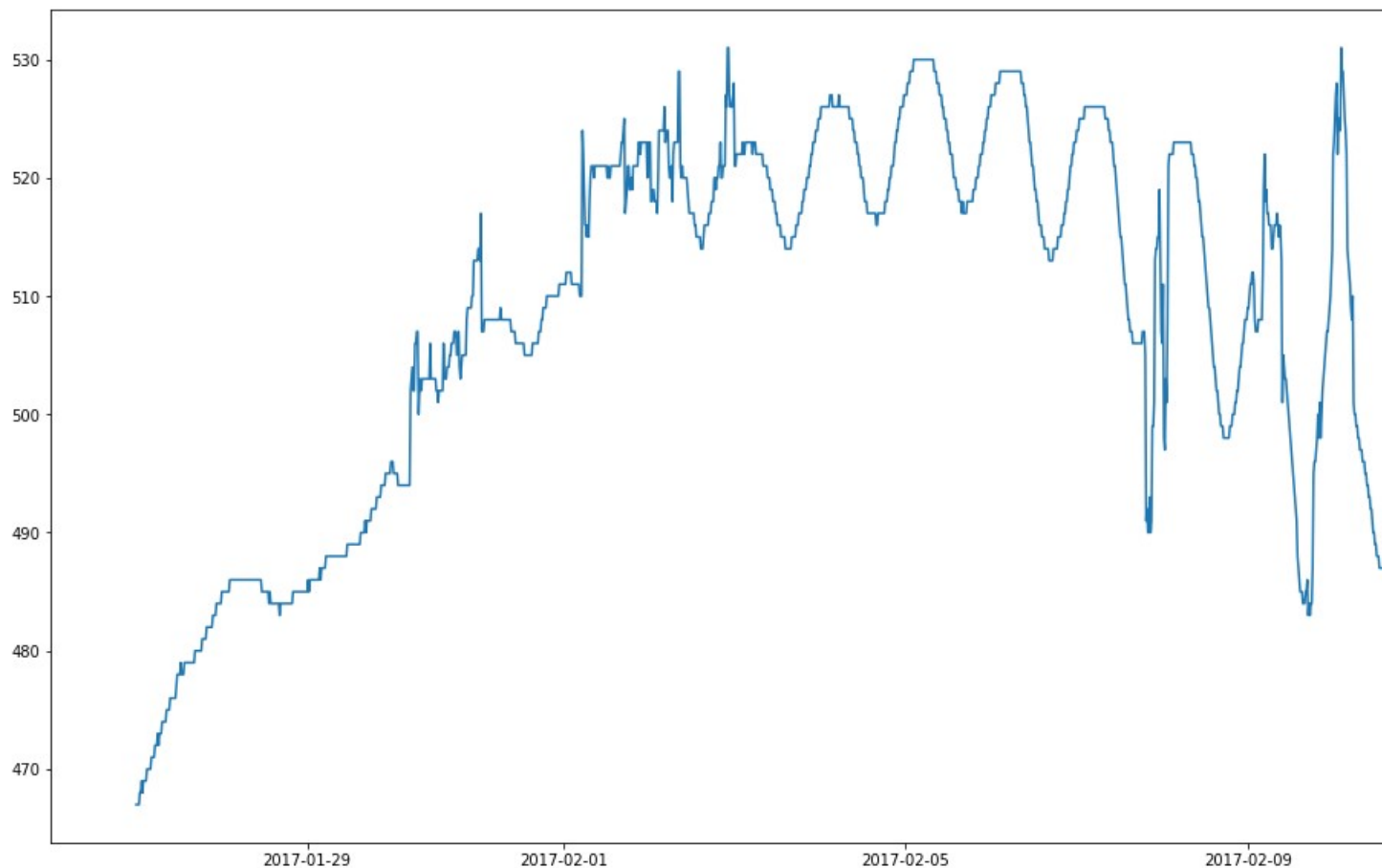
```
In [44]: ts = sc_train
...: model = ARIMA(ts, order=(1,0,1)) # (ARMA) = (p,d,q)
...: model_fit = model.fit(dispatch=0)
...:
```

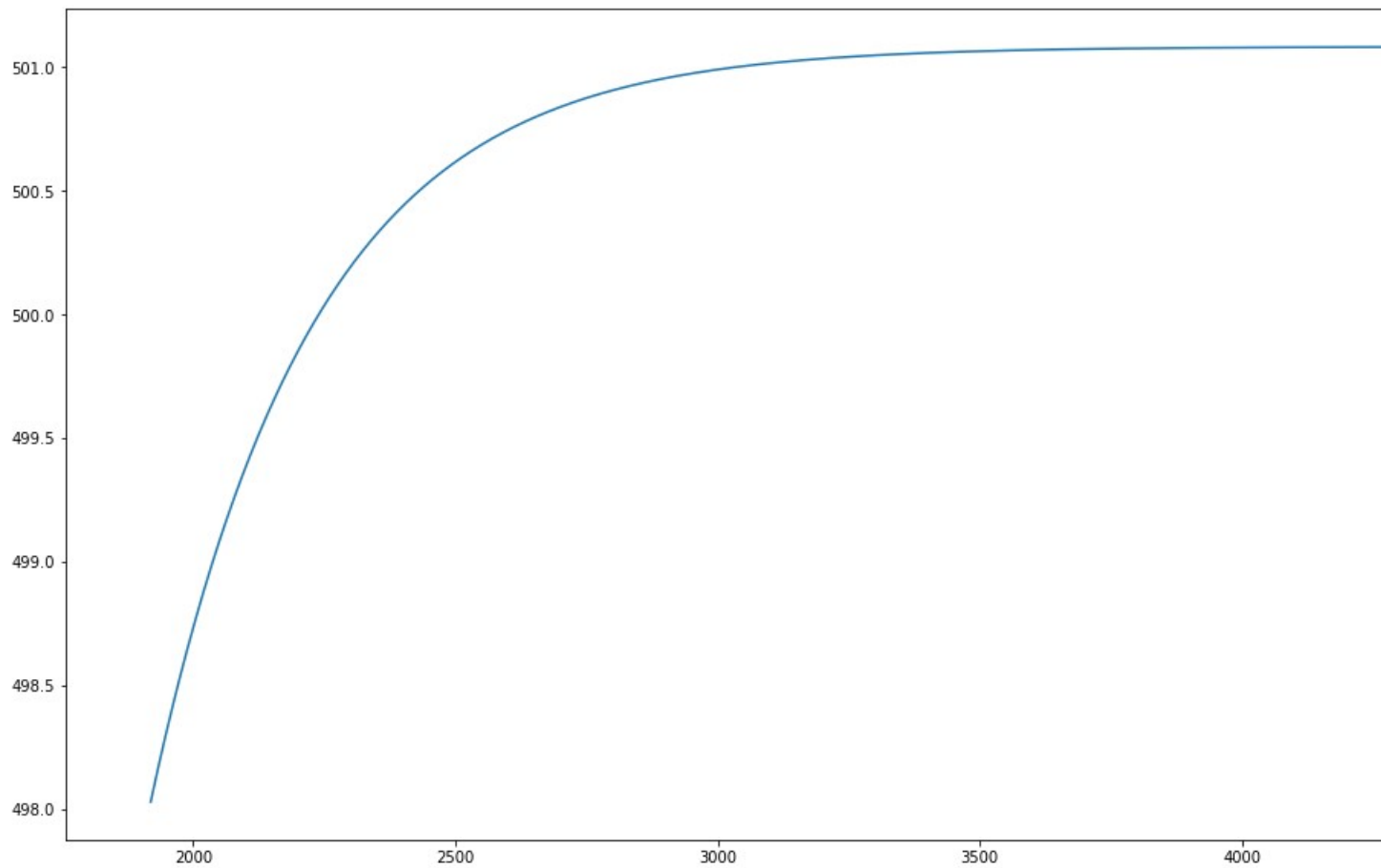
```

....: # predict
....: forecast = model_fit.predict(start=1919, end=5171)
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:225:
ValueWarning: A date index has been provided, but it has no associated frequency
information and so will be ignored when e.g. forecasting.
' ignored when e.g. forecasting.', ValueWarning)
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:531:
ValueWarning: No supported index is available. Prediction results will be given with an
integer index beginning at `start`.
ValueWarning)

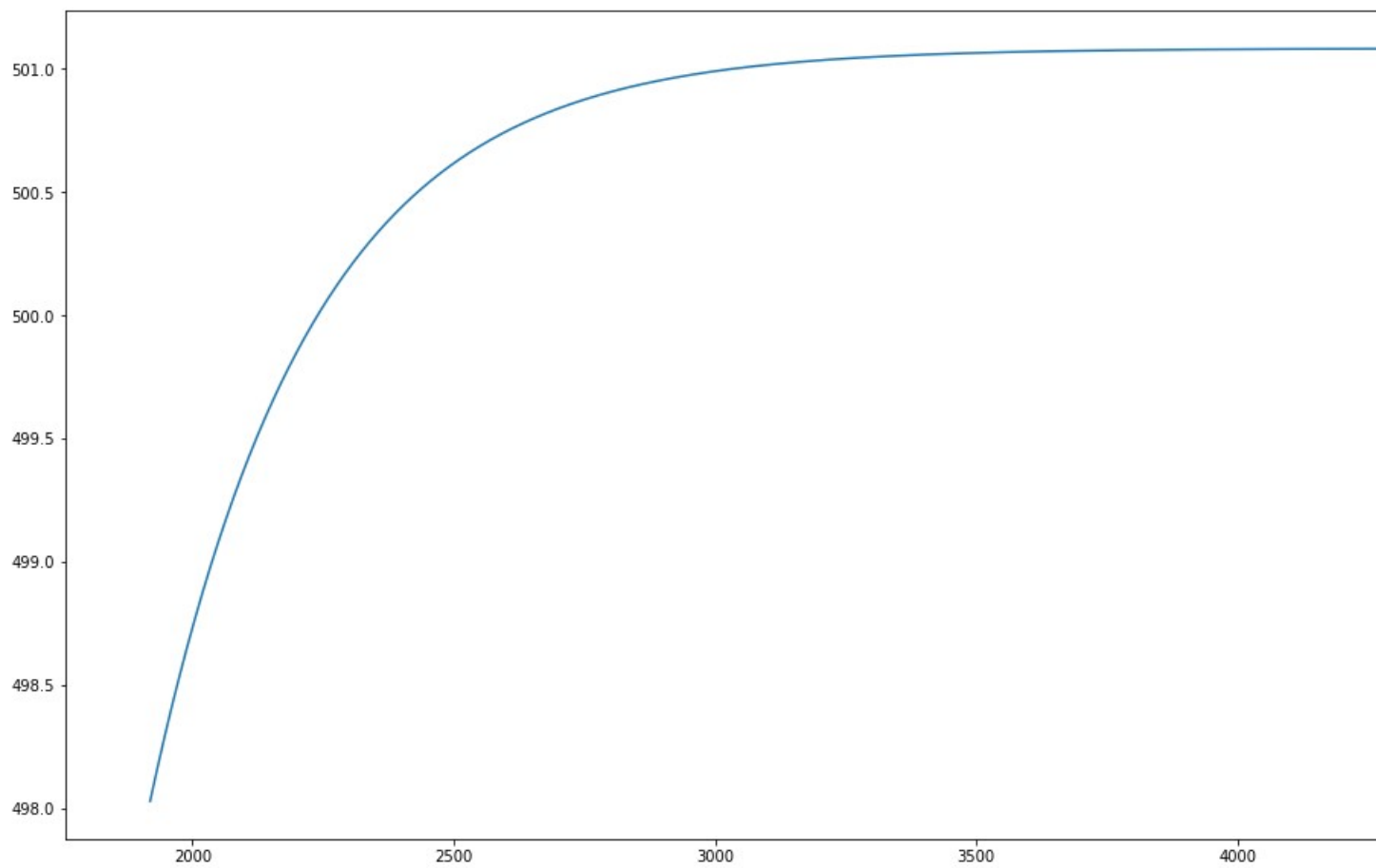
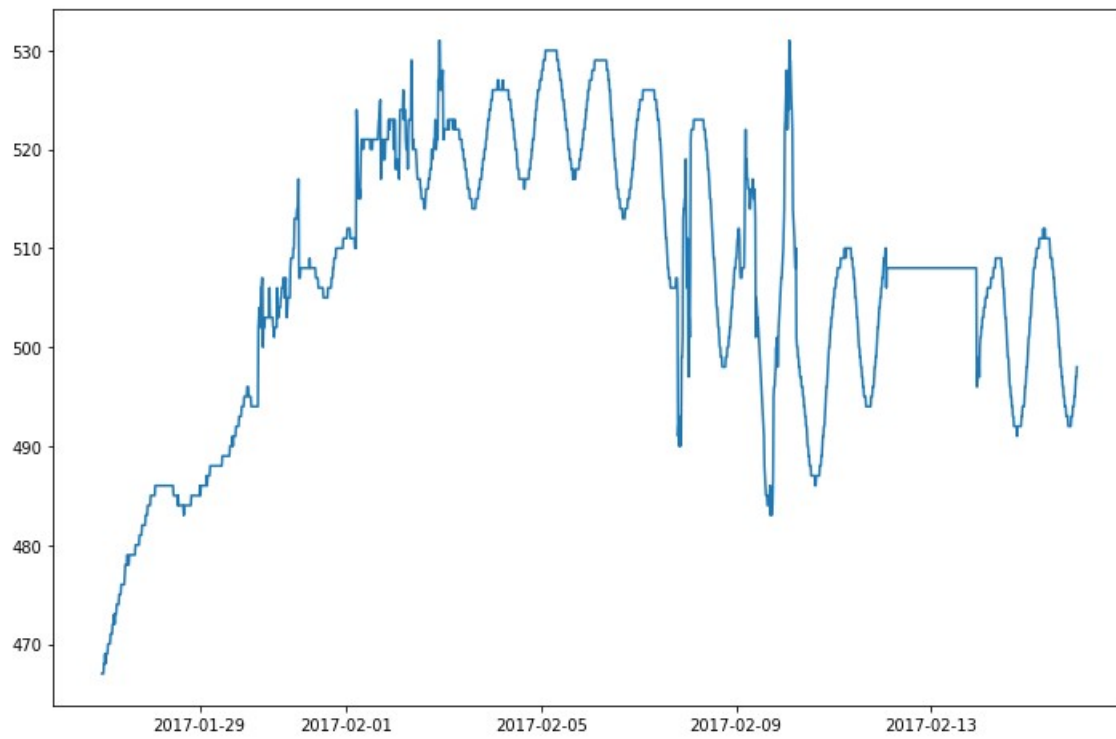
In [45]: plt.figure(figsize=(22,10))
....: plt.plot(sc_train,label = "original")
....: plt.figure(figsize=(22,10))
....: plt.plot(forecast,label = "predicted")
Out[45]: [matplotlib.lines.Line2D at 0x16fb5d54780<]

```





```
In [46]: plt.figure(figsize=(12,8))
...: plt.plot(sc_train,label = "original")
...: plt.figure(figsize=(22,10))
...: plt.plot(forecast,label = "predicted")
Out[46]: [<matplotlib.lines.Line2D at 0x16fb5d282b0>]
```



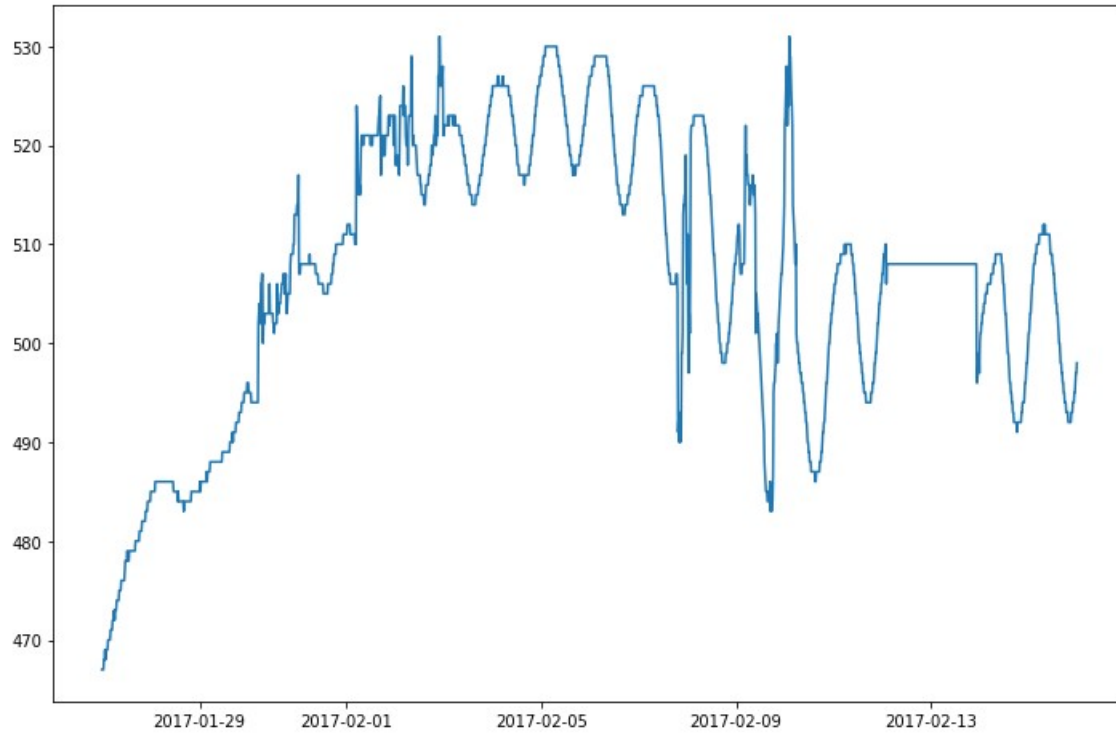
```
In [47]: plt.figure(figsize=(12,8))
```

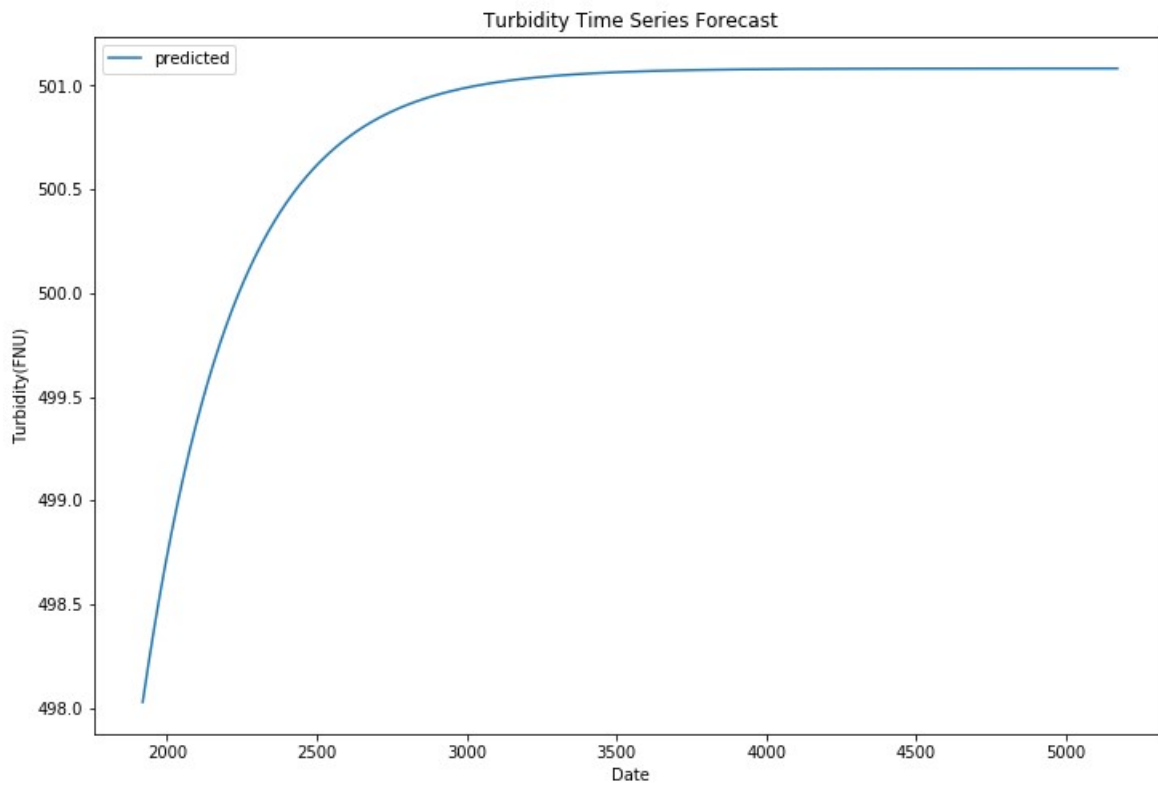


```

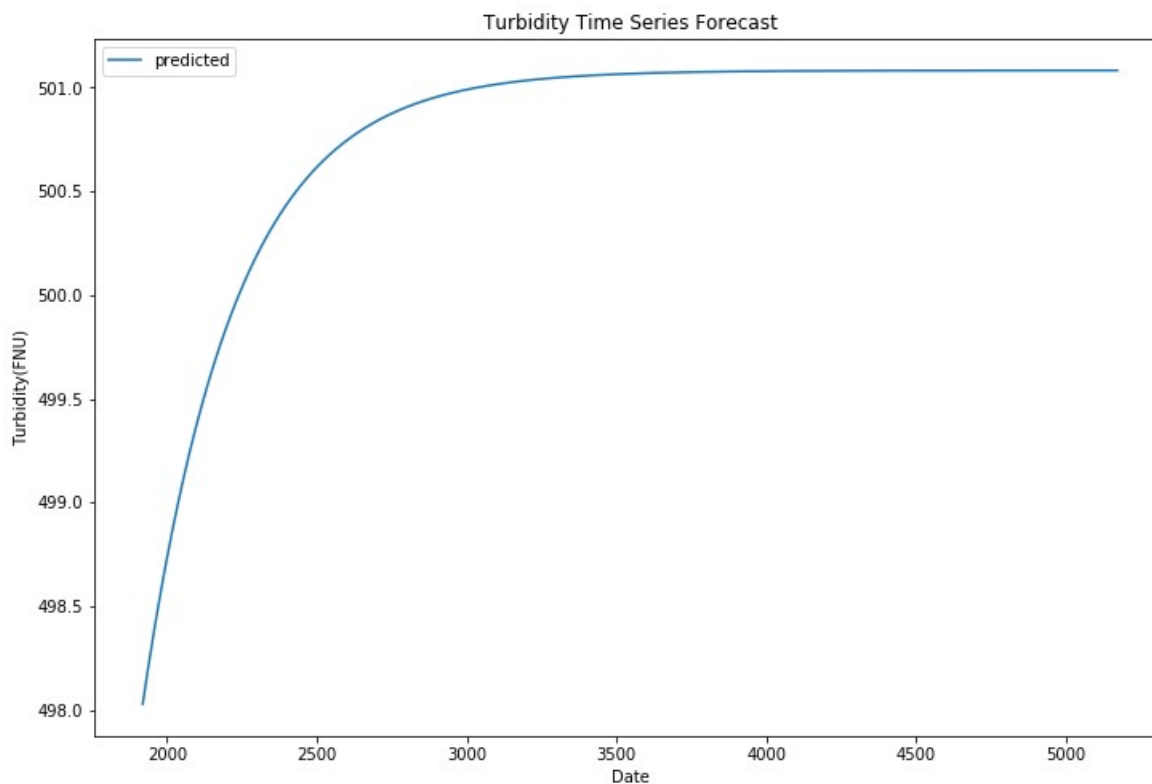
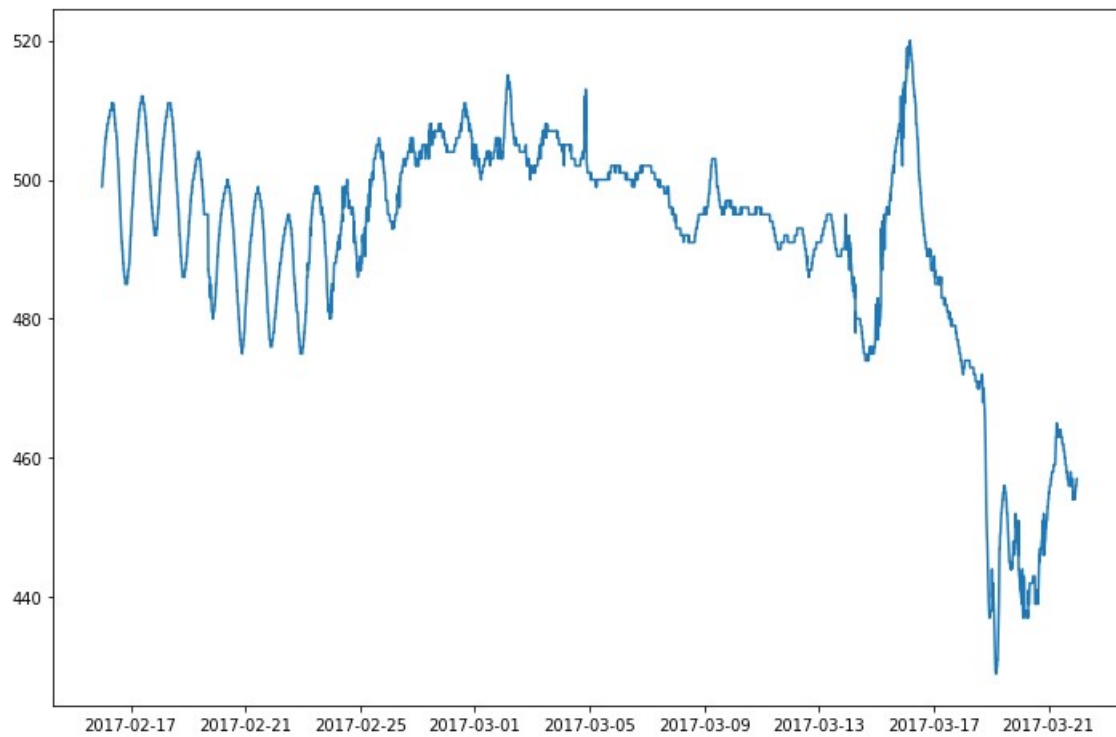
....: plt.plot(sc_train,label = "original")
....: plt.figure(figsize=(12,8))
....: plt.plot(forecast,label = "predicted")
....: plt.title("Turbidity Time Series Forecast")
....: plt.xlabel("Date")
....: plt.ylabel("Turbidity(FNU)")
....: plt.legend()
....: plt.show()

```





```
In [48]: plt.figure(figsize=(12,8))
...: plt.plot(sc_test,label = "original")
...: plt.figure(figsize=(12,8))
...: plt.plot(forecast,label = "predicted")
...: plt.title("Turbidity Time Series Forecast")
...: plt.xlabel("Date")
...: plt.ylabel("Turbidity(FNU)")
...: plt.legend()
...: plt.show()
```

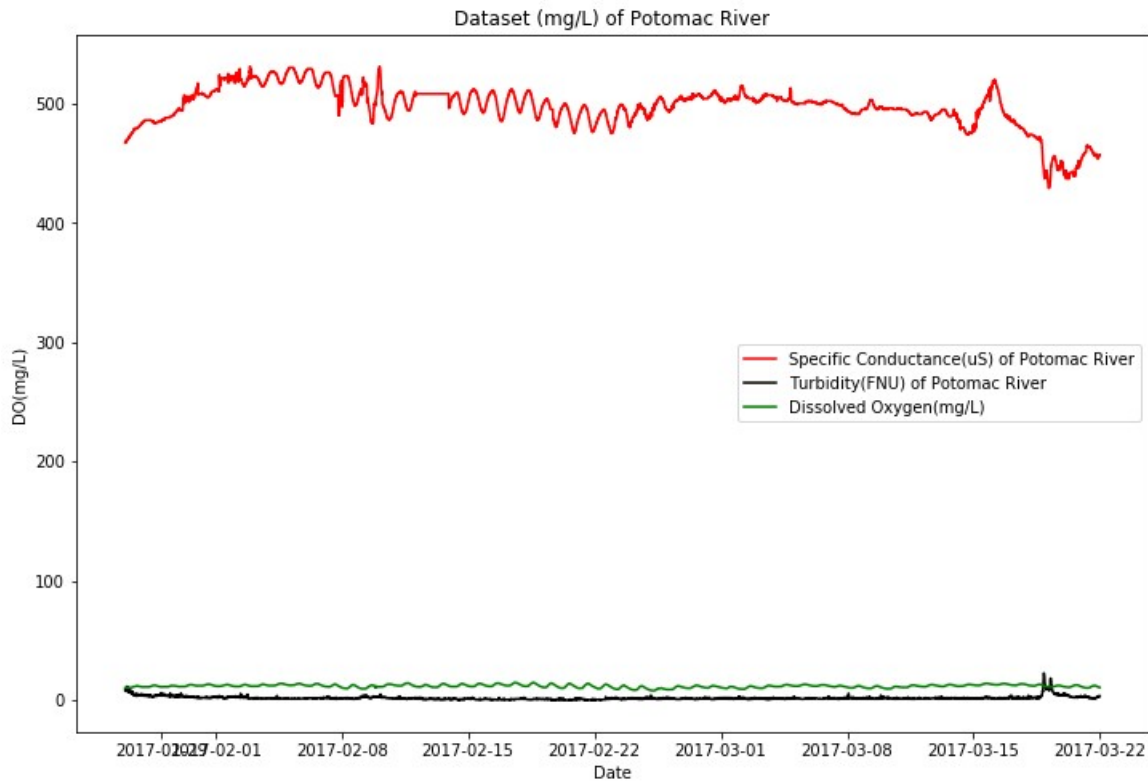


```
In [49]: plt.figure(figsize=(12,8))
...: plt.plot(sc,label="Specific Conductance(uS) of Potomac River",color='red')
...: plt.plot(turb,label="Turbidity(FNU) of Potomac River",color='black')
...: plt.plot(do,label="Dissolved Oxygen(mg/L)",color='green')
...: plt.title("Dataset (mg/L) of Potomac River")
```

```

....: plt.xlabel("Date")
....: plt.ylabel("DO(mg/L)")
....: plt.legend()
....: plt.show()
....: plt.show()

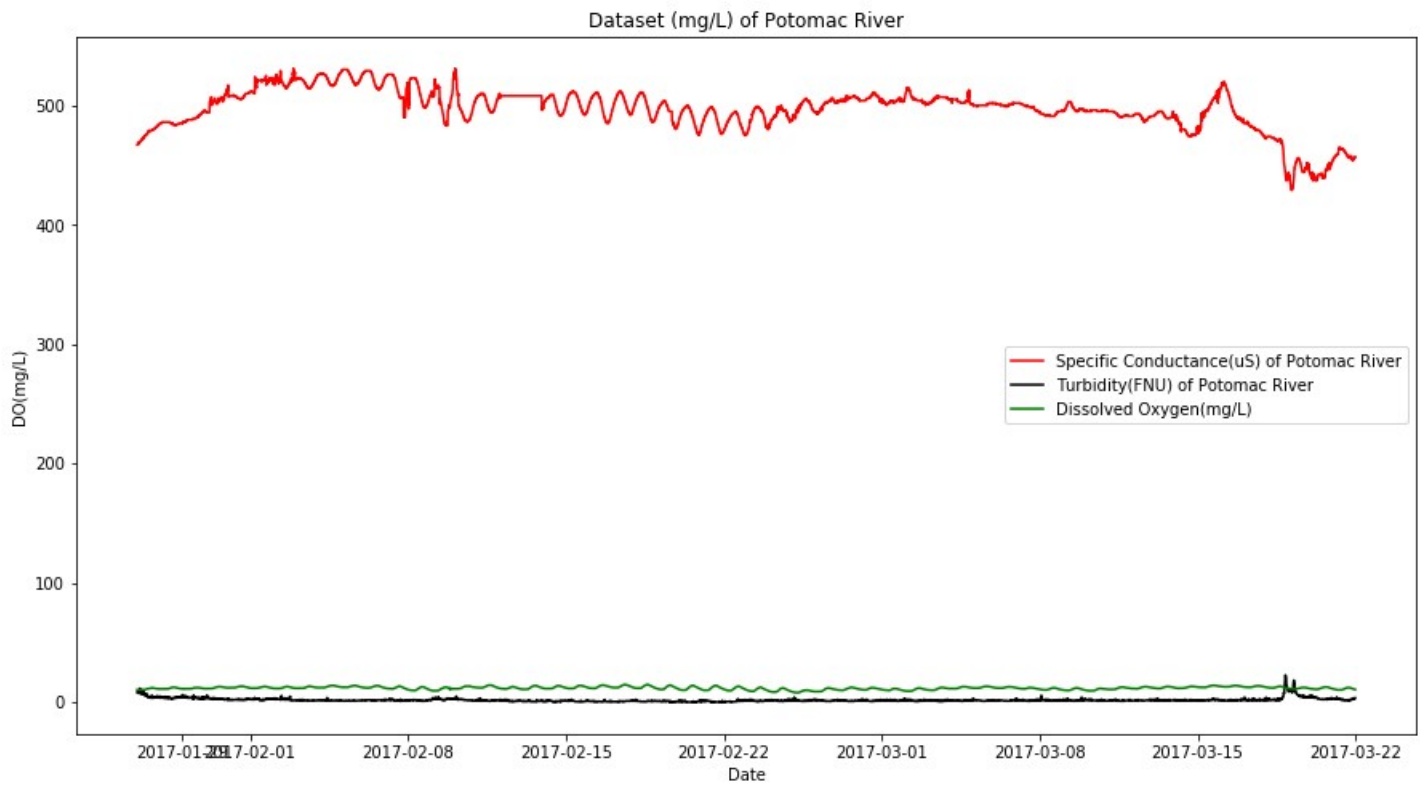
```



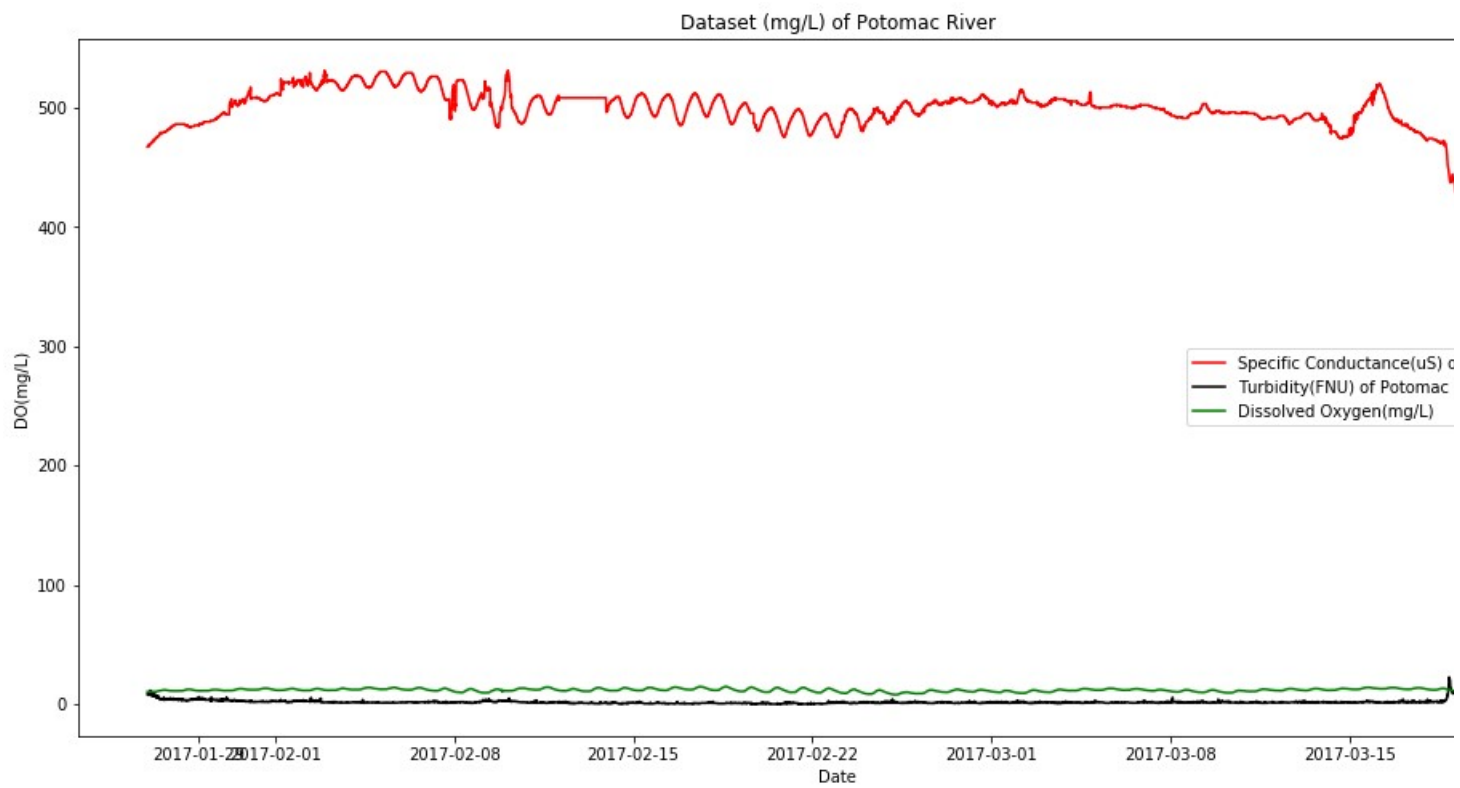
```

In [50]: plt.figure(figsize=(15,8))
....: plt.plot(sc,label="Specific Conductance(uS) of Potomac River",color='red')
....: plt.plot(turb,label="Turbidity(FNU) of Potomac River",color='black')
....: plt.plot(do,label="Dissolved Oxygen(mg/L)",color='green')
....: plt.title("Dataset (mg/L) of Potomac River")
....: plt.xlabel("Date")
....: plt.ylabel("DO(mg/L)")
....: plt.legend()
....: plt.show()
....: plt.show()

```



```
In [51]: plt.figure(figsize=(17,8))
...: plt.plot(sc,label="Specific Conductance(uS) of Potomac River",color='red')
...: plt.plot(turb,label="Turbidity(FNU) of Potomac River",color='black')
...: plt.plot(do,label="Dissolved Oxygen(mg/L)",color='green')
...: plt.title("Dataset (mg/L) of Potomac River")
...: plt.xlabel("Date")
...: plt.ylabel("DO(mg/L)")
...: plt.legend()
...: plt.show()
...: plt.show()
```



In [52]:

Removing all variables...

In [52]: