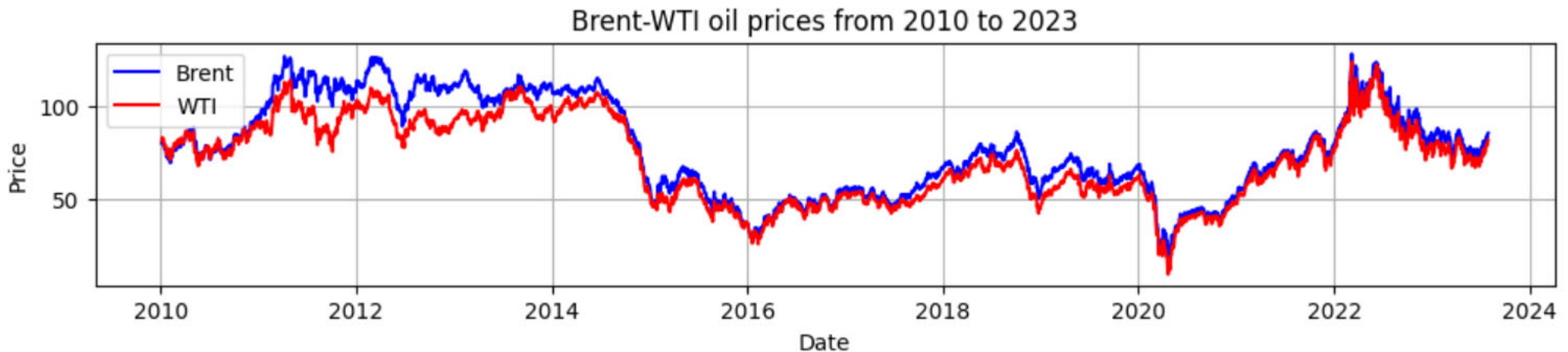
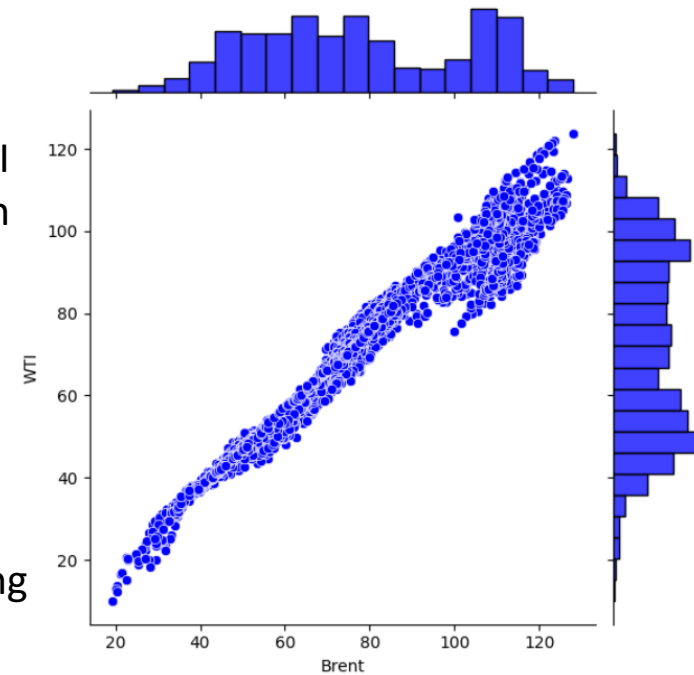
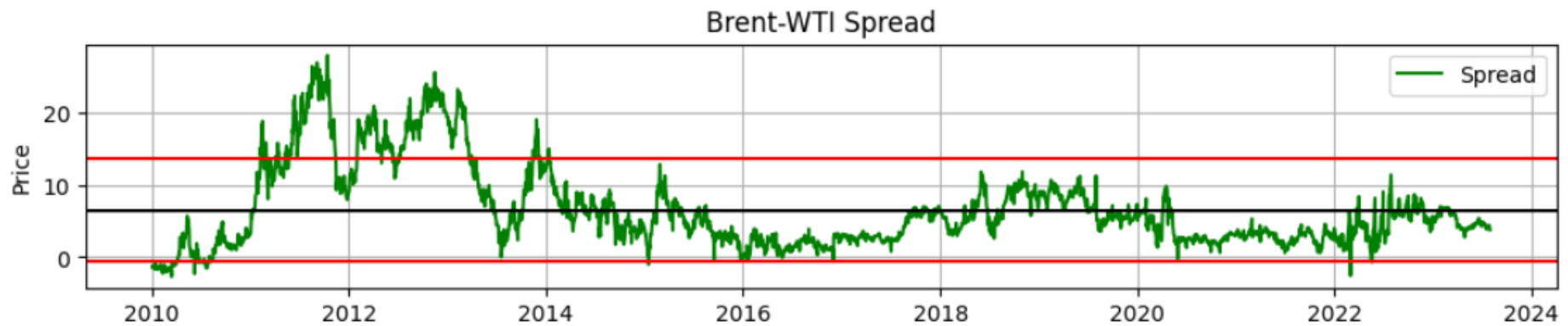


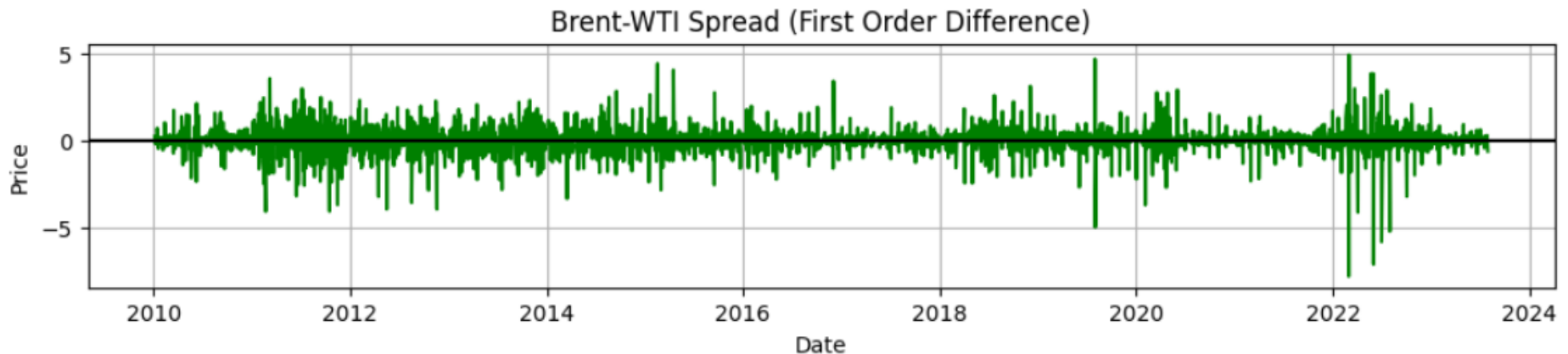
Analysis of Brent-WTI spread

- Brent oil price ranges between 19\$-128\$ with a mean value of 77\$. WTI oil price ranges between 10\$ to 123\$ with an average value of 71\$. Both series are non-stationary. That means that their statistical properties (mean, variance, autocorrelation) change over time. This makes sense, since the price of oil is influenced by external factors/trends like globalization, technology, etc.
- Brent oil prices and WTI oil prices are strongly correlated as well as co-integrated. This means that their prices move together throughout a long time period, with Brent being costlier than WTI by 6\$ on average.



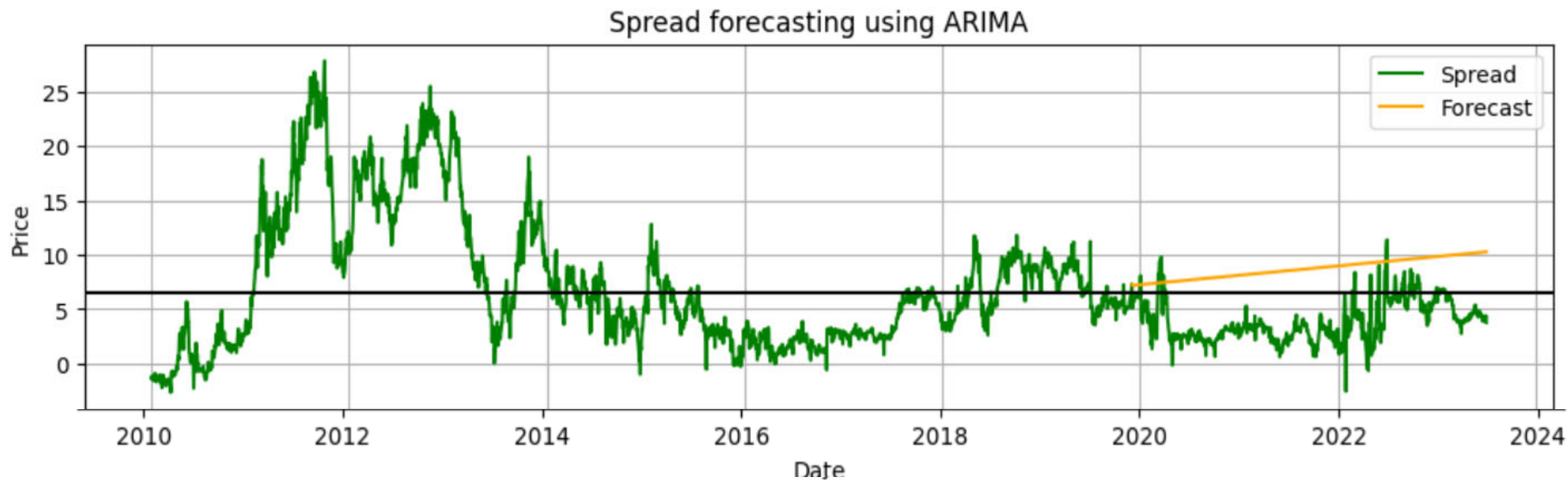


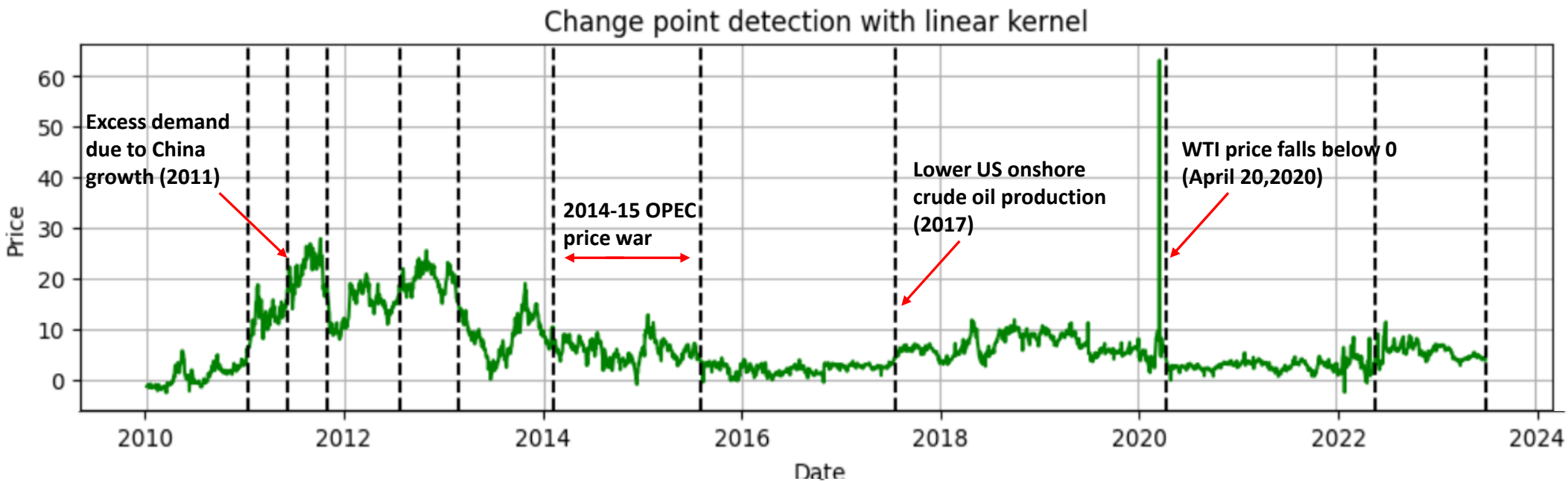
- The WTI-Brent spread is a stationary time series, which means that its statistical properties remain constant over a long period. This implies that both Brent and WTI oil prices are influenced by the same factors, which tends to cancel out their individual upward/downward trends in their spread.
- The WTI-Brent spread is mean reverting (Hurst exponent=0.4), with a half life of 71 days. This means that it takes approximately 71 days for global markets to force price-readjustment and bring it to mean value of 6.5\$.



Predicting Future Spread Movements

We can use statistical techniques such as the Auto Regressive Integrated Moving Average (ARIMA) model to forecast the direction of spread movement in the future. Here I have trained the model on the spread data from 2010-2020 and forecasted the direction of spread movement from 2020-2023. However, this technique is useful only for short time periods, as it cannot handle the complexity of various factors influencing oil prices (see next slide).





Identifying change points in Brent-WTI Spread

Oil prices can be influenced by long term trends (globalization, inflation) as well as geopolitical shocks (Ukraine-Russia conflict, 2020 pandemic lockdowns). We can use change point detection algorithms to identify significant shifts in the price of oil to understand those impacts. In this analysis, **kernel change detection algorithm** has been applied which accepts the number of change points as input, and identifies their location in the time series, based on goodness of fit.