



11th International SuperComputing Camp 2020

Time Series Forecasting

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Outline

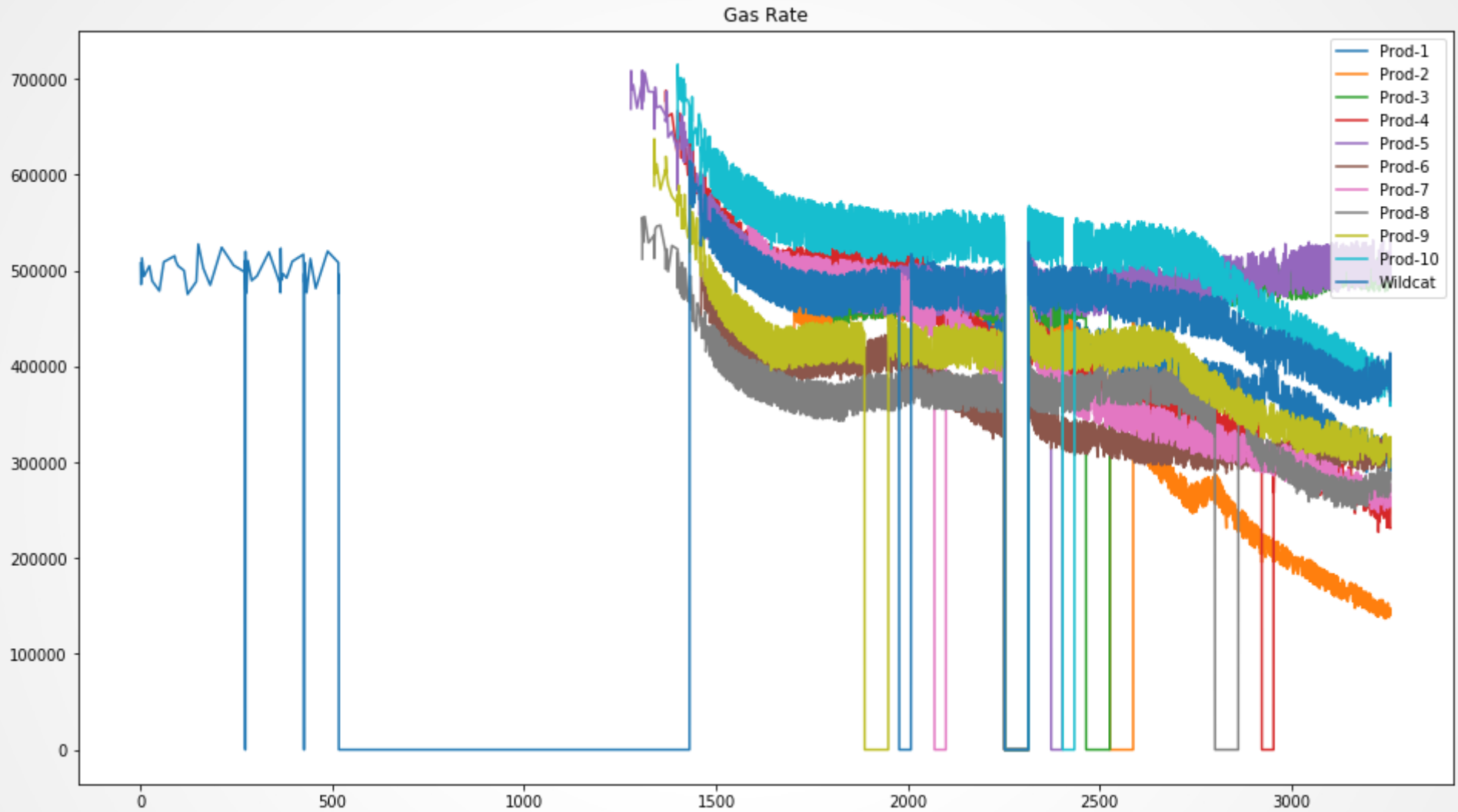
Definition: time series

Classical analysis

HPC Forecasting

Examples

Time Series



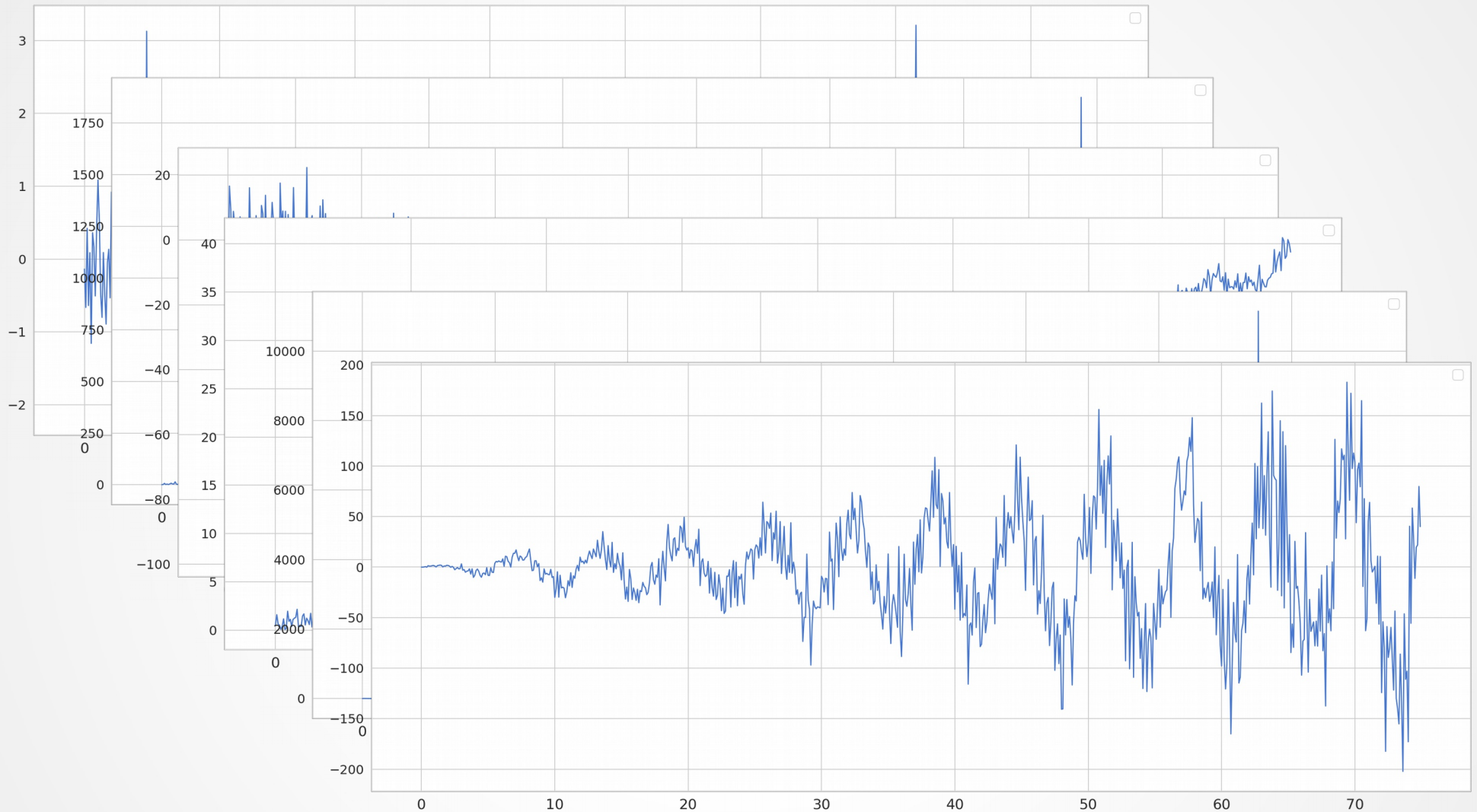
Time Series

Definition: $F(t)$

Applications:

Statistics, signal processing, pattern recognition, econometrics, weather forecasting, earthquake prediction, electromedicine, control engineering, astronomy, communications, Oil & Gas...

Time series



Classical Analysis

Regression techniques

Linear prediction

Curve Fitting

Exponential smoothing

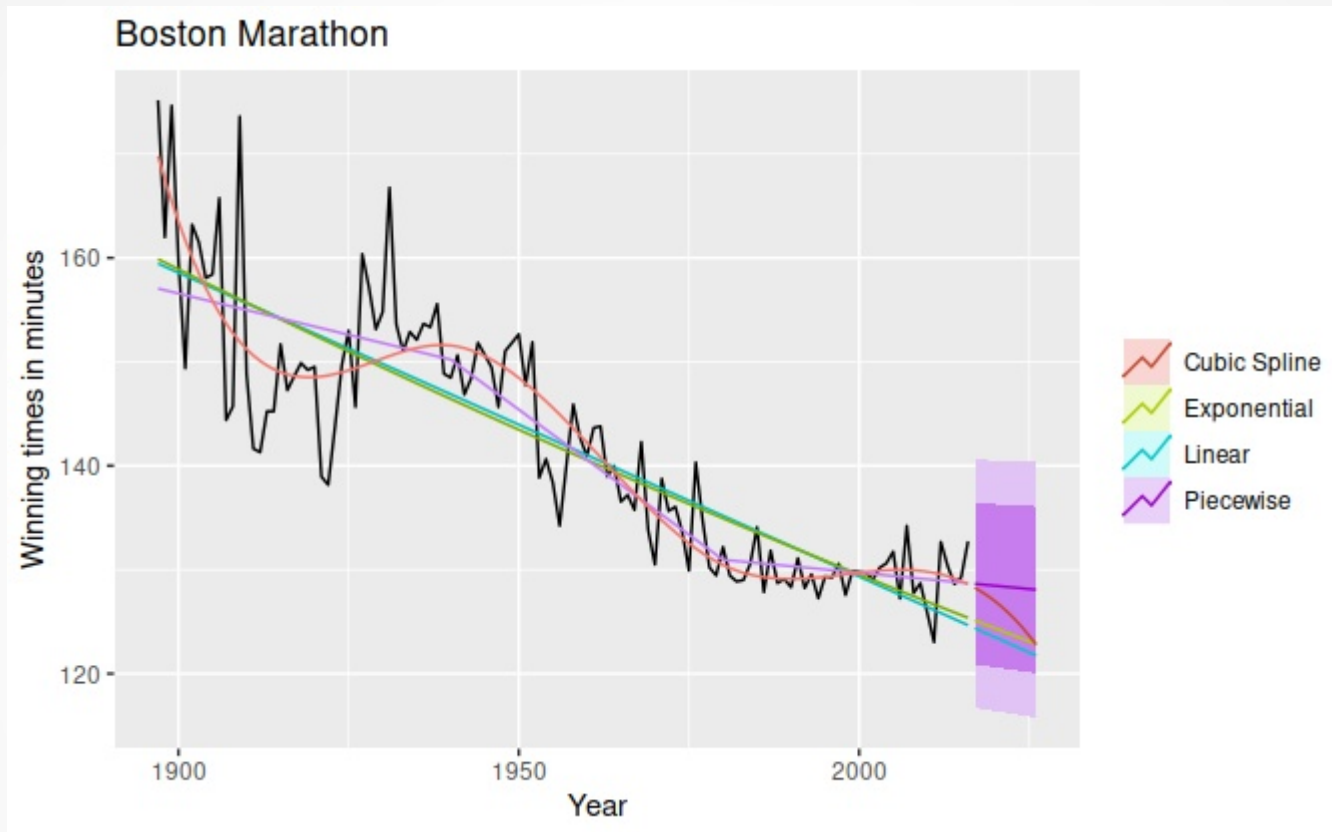
Auto-correlation

Spectral analysis

Function approximation

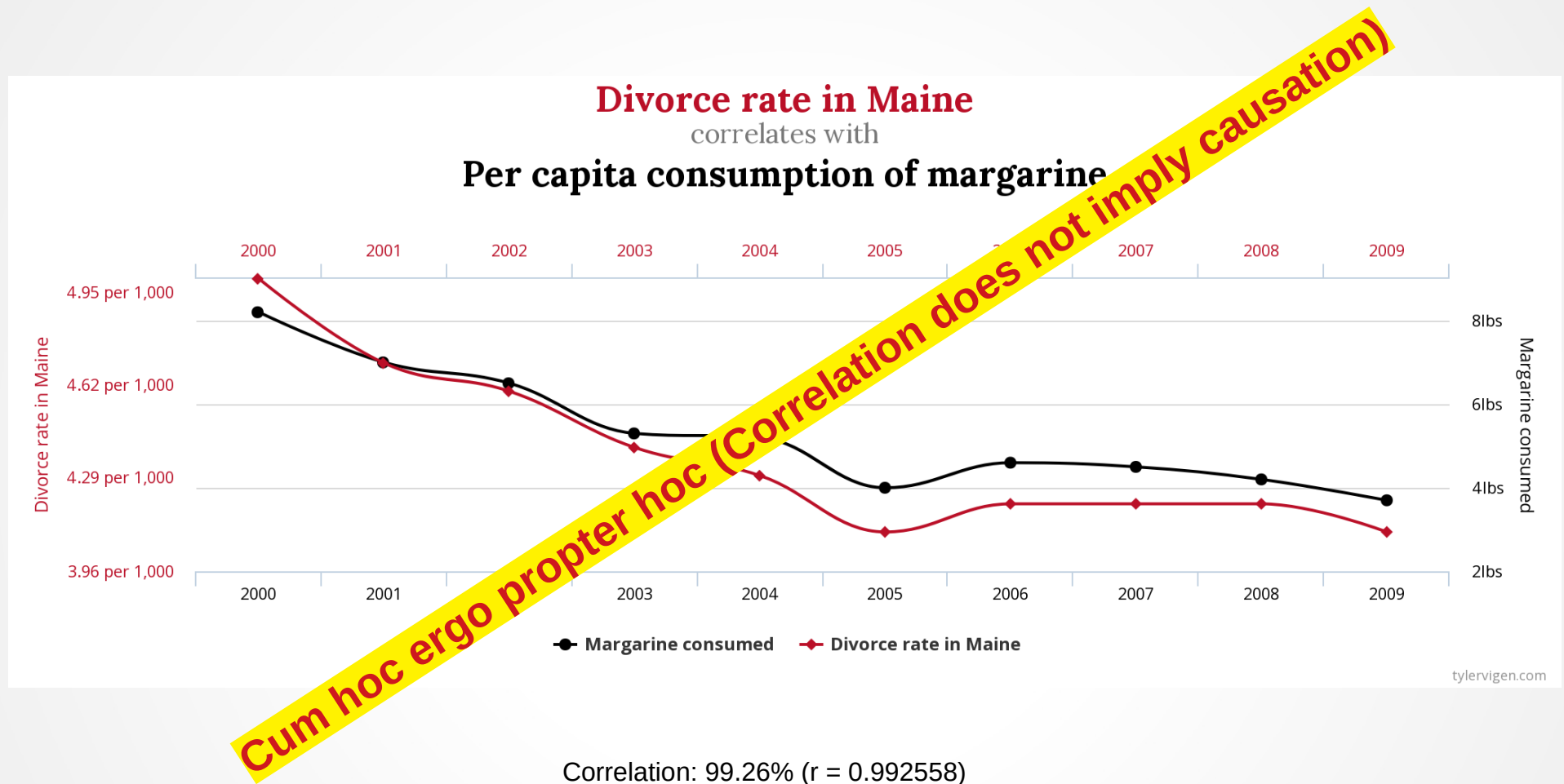
Interpolation

Classical Analysis



Source: <https://otexts.com/fpp2/nonlinear-regression.html>

WARNING!, STOP!, DANGER!



Source: <http://www.tylervigen.com/spurious-correlations>

HPC Forecasting

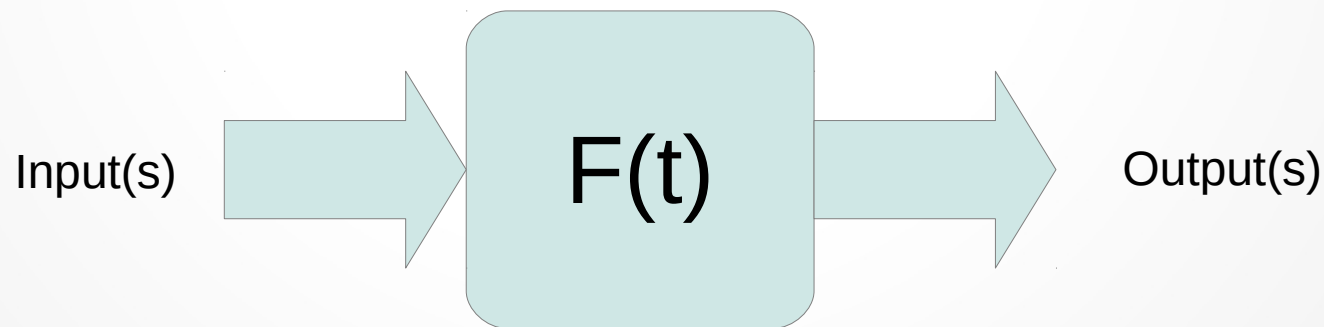
Long term forecasting

Time resolution

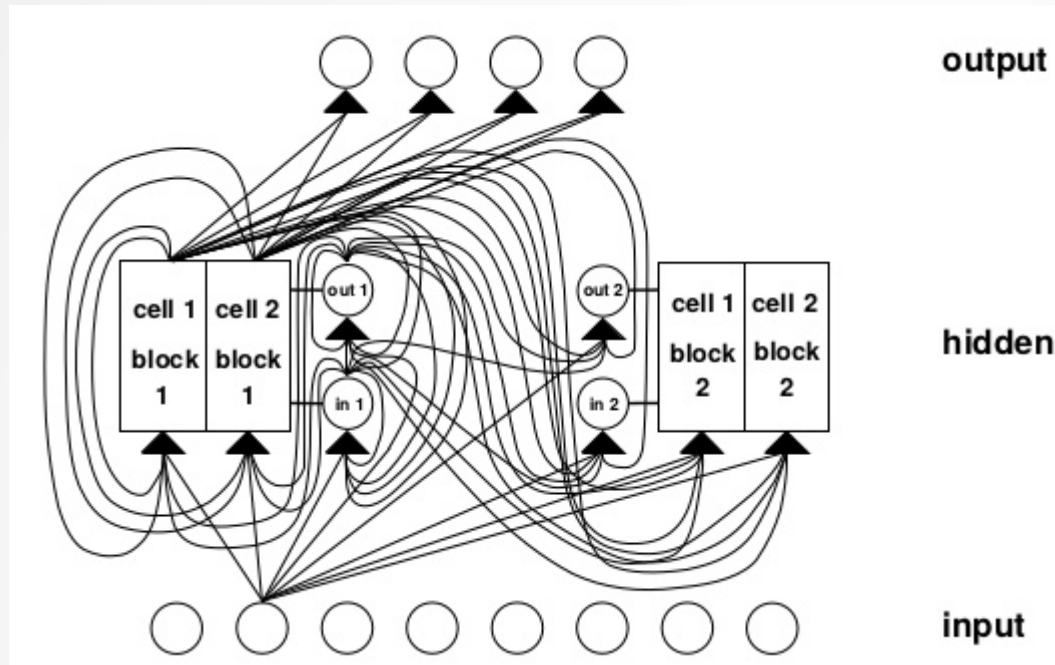
Several Inputs/outputs

Artificial Intelligence + HPC

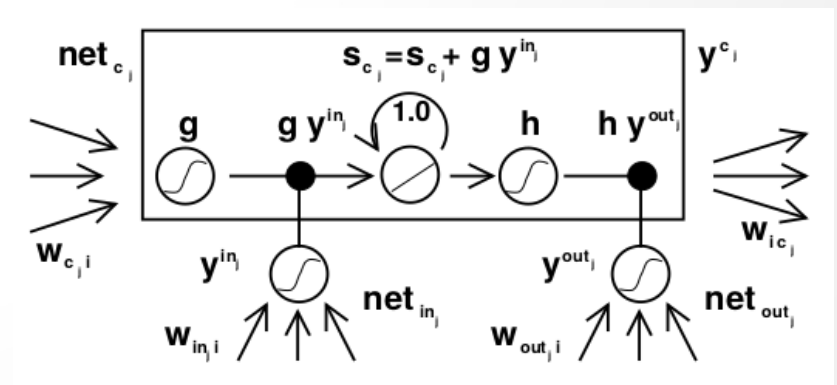
Recurrent Neural Networks



Long Short-Term Memory (LSTM)



Source: Hochreiter, S. and Schmidhuber, J. LONG SHORT-TERM MEMORY, 1997



Examples

$$f(t) = \sin(t) + \text{noise}(t)$$

Air Quality, source:

<https://towardsdatascience.com/time-series-analysis-on-multivariate-data-in-tensorflow-2f0591088502>

Steps

Collecting historical dataset

Data engineering (Pre-processing)

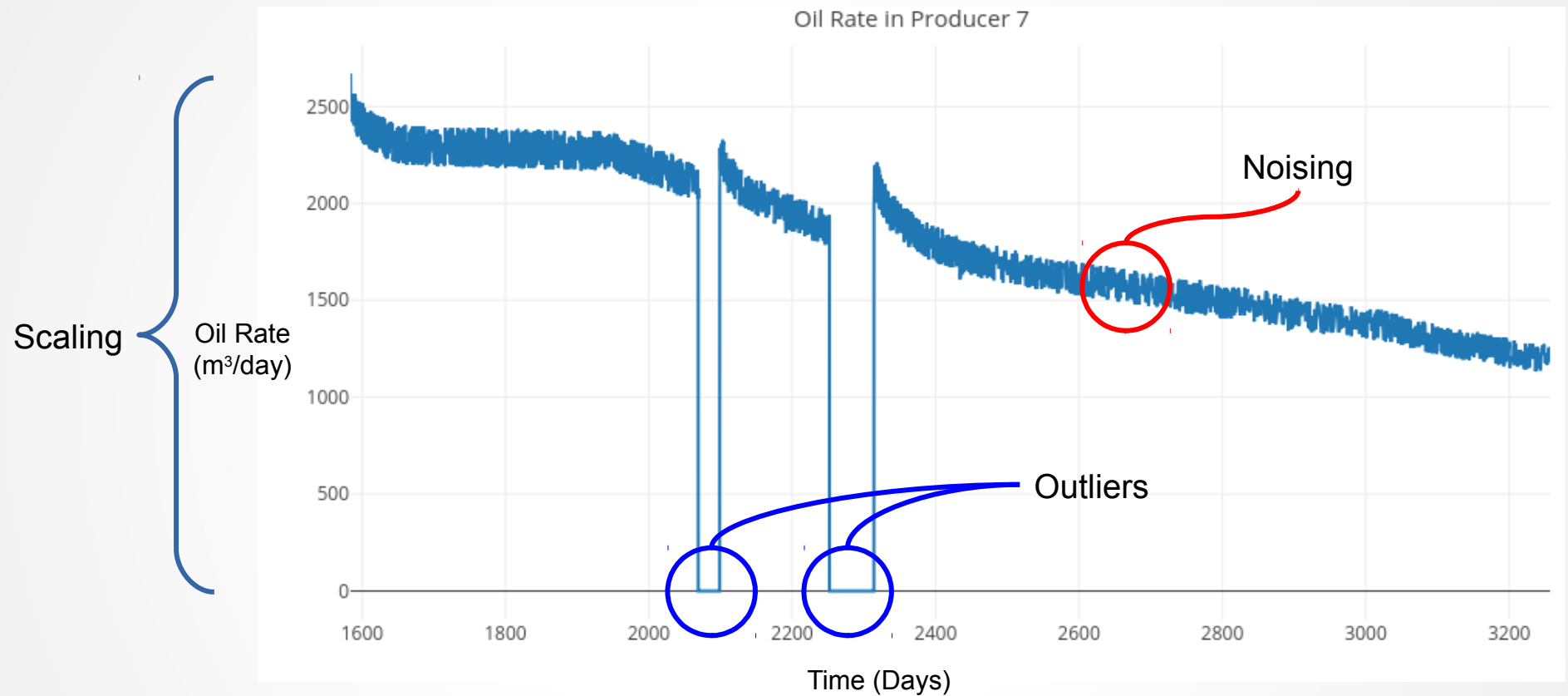
Data augmentation (interpolation, smoothing...)

Model Design (CNN, RNN, LSTM, GRU...)

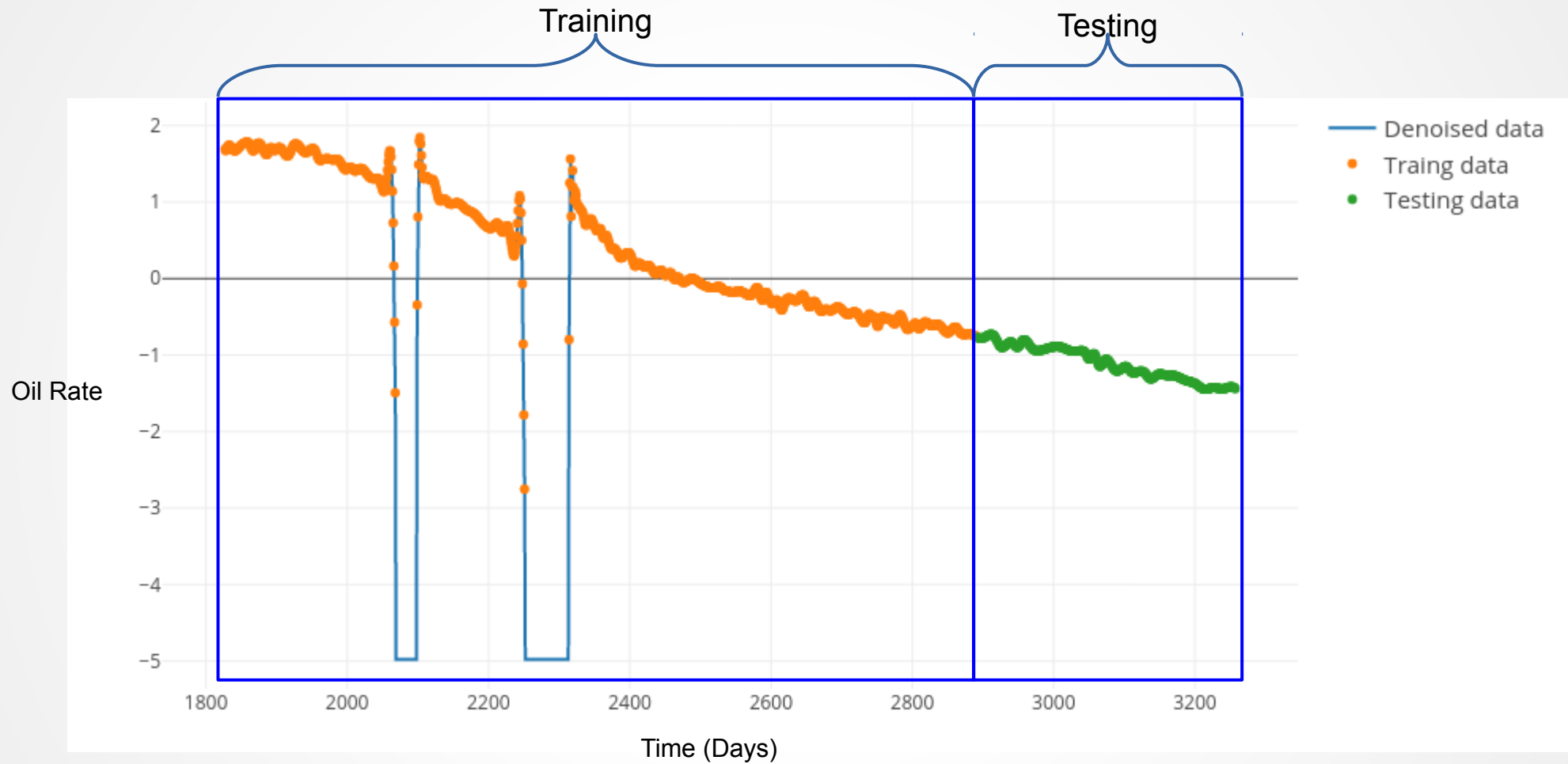
Training (GPU libraries – Keras, Pytorch...)

Testing

Data Pre-processing

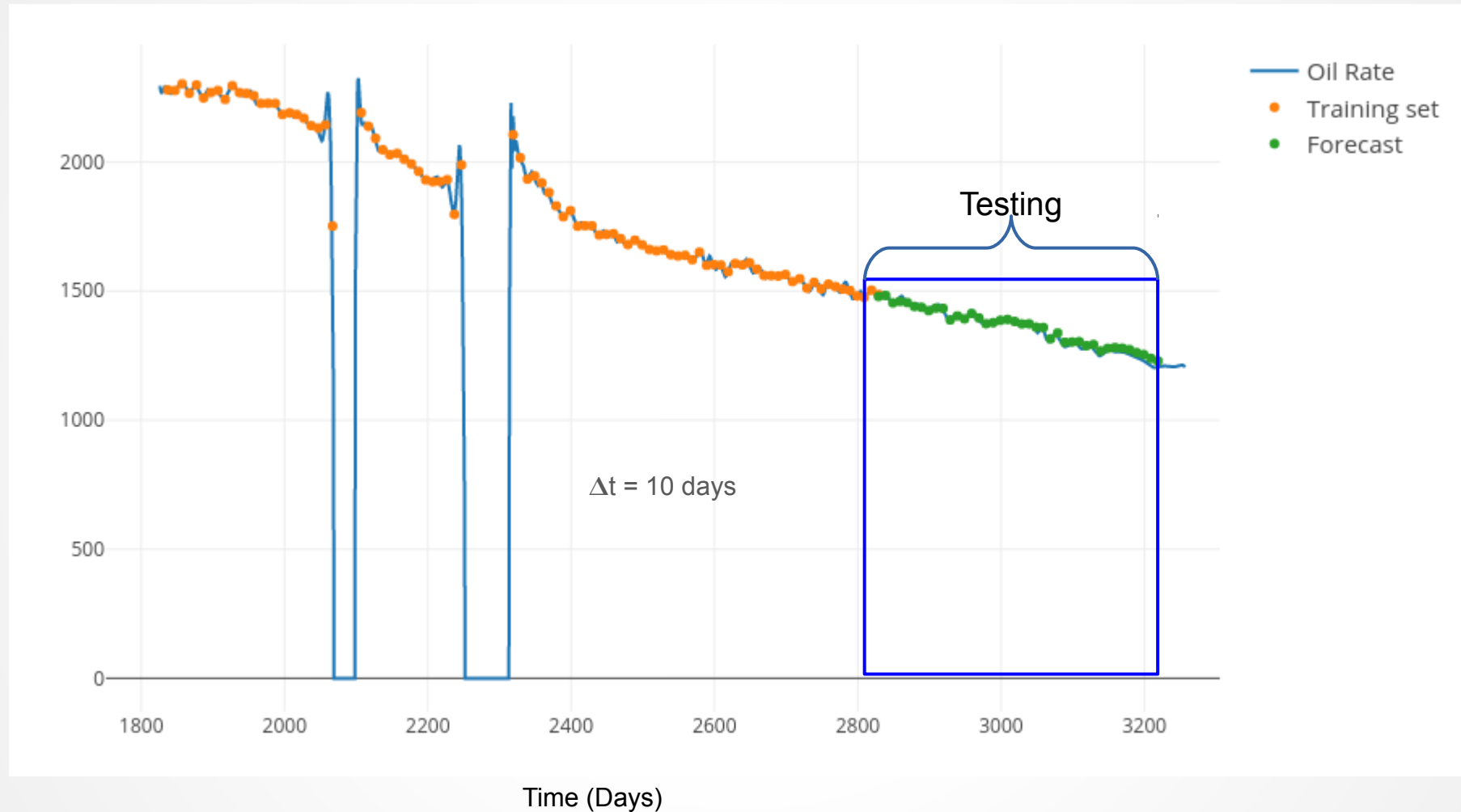


Data Pre-processing



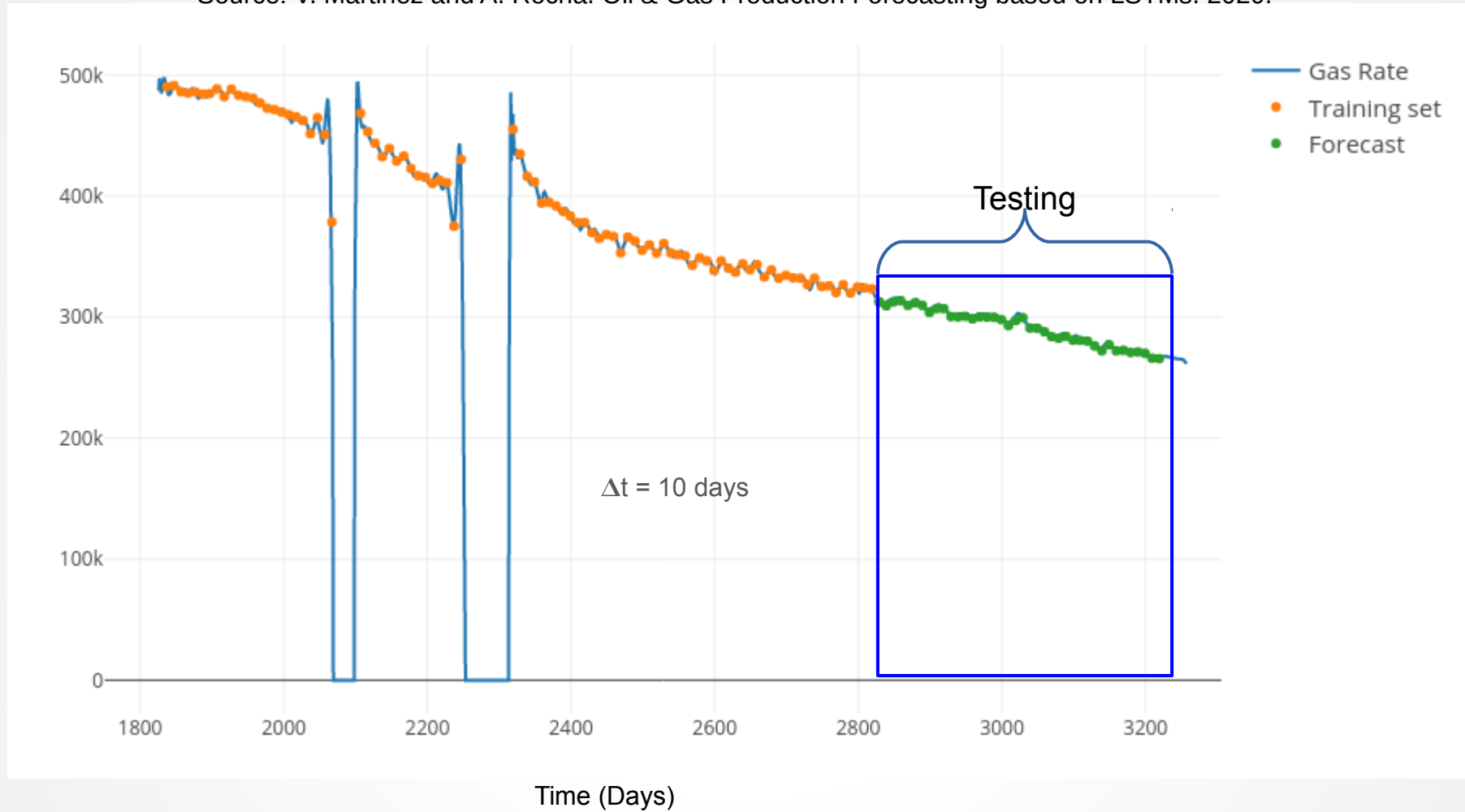
Example: Oil Forecasting

Source: V. Martinez and A. Rocha. Oil & Gas Production Forecasting based on LSTMs. 2020.



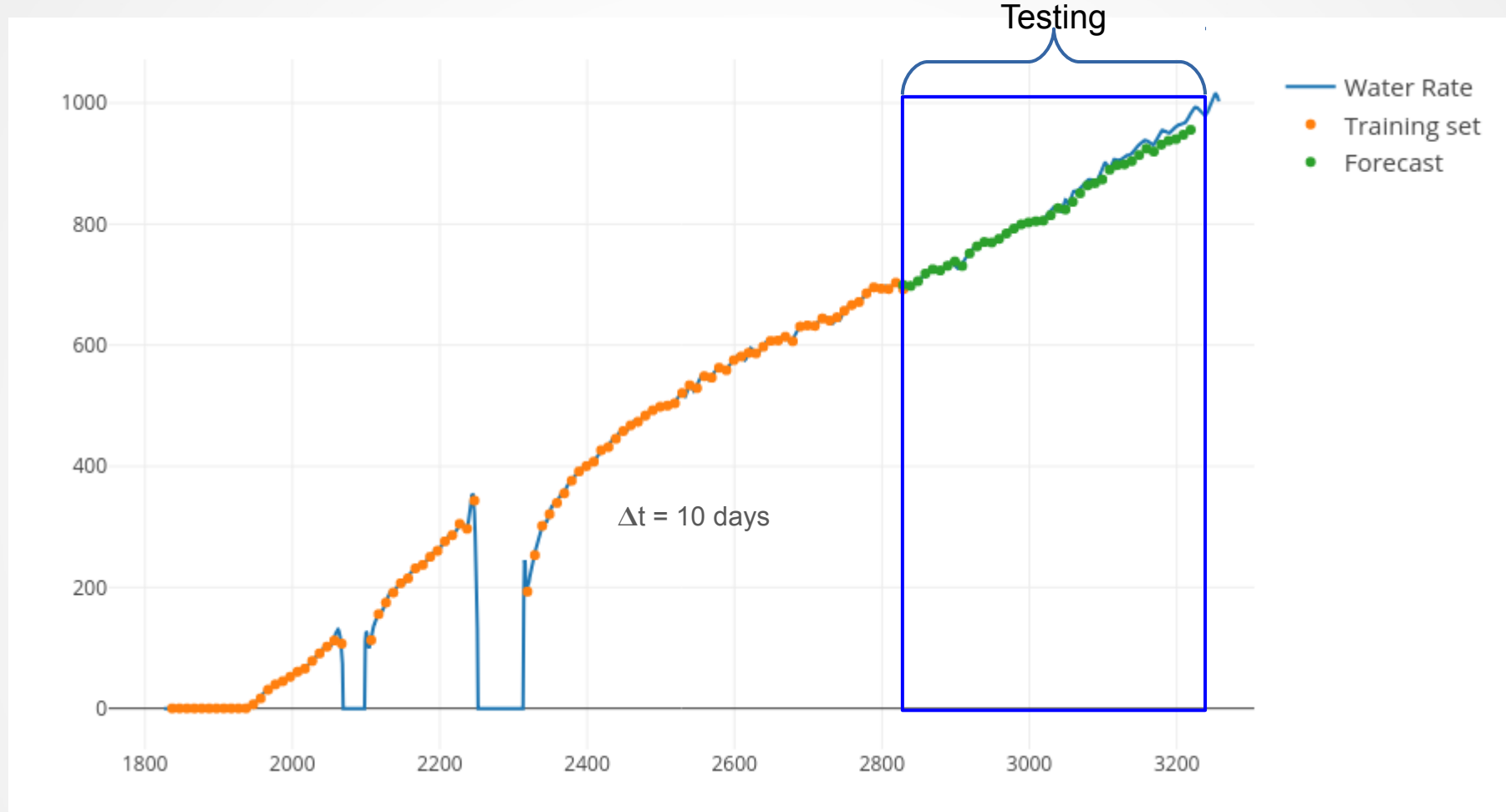
Example: Gas Forecasting

Source: V. Martinez and A. Rocha. Oil & Gas Production Forecasting based on LSTMs. 2020.



Example: Water Forecasting

Source: V. Martinez and A. Rocha. Oil & Gas Production Forecasting based on LSTMs. 2020.



Thanks!



“
Correlation does not imply causation
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