

Predictive maintenance to prevent drifts applied to gas pressure reduction and delivery stations

GRTgaz

- French Transmission System Operator (TSO), transmitting over 700 TWh of gas annually from suppliers to customers
- Owner and operator of more than 32,500 km of gas pipeline and about 5,000 gas pressure reduction and delivery stations

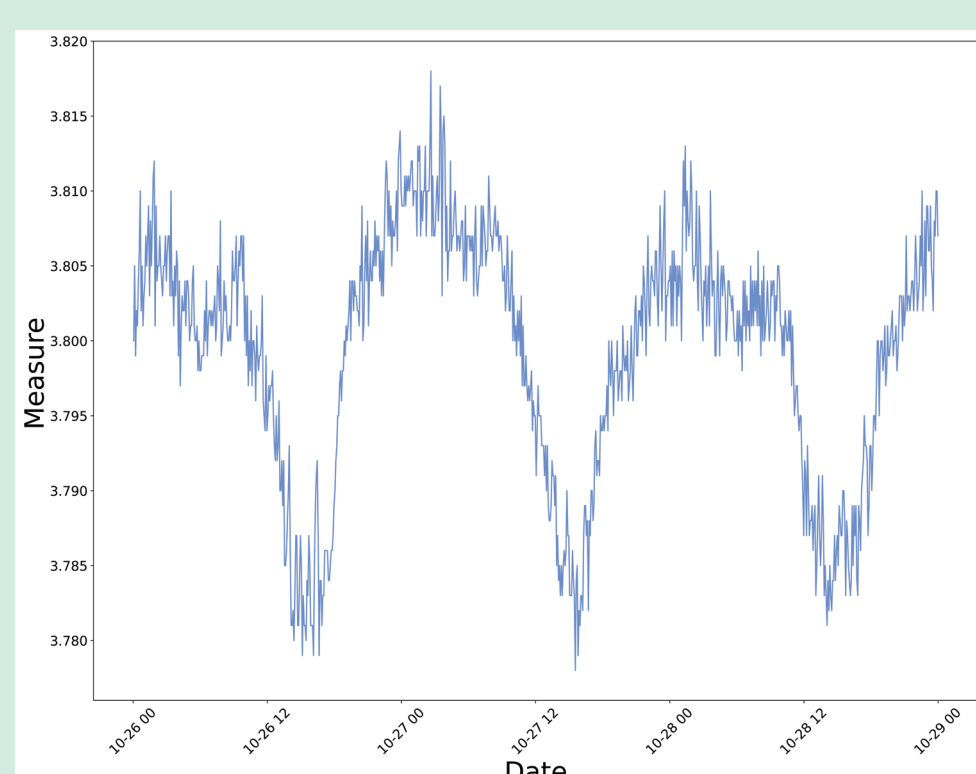
Pressure recorders

- Mandatory for measuring and recording the downstream pressure of gas delivery stations
- Digitalization of systems since 2020, allowing remote access to pressure measurements
- Opportunity for identifying potential pressure drifts and anticipating maintenance operations

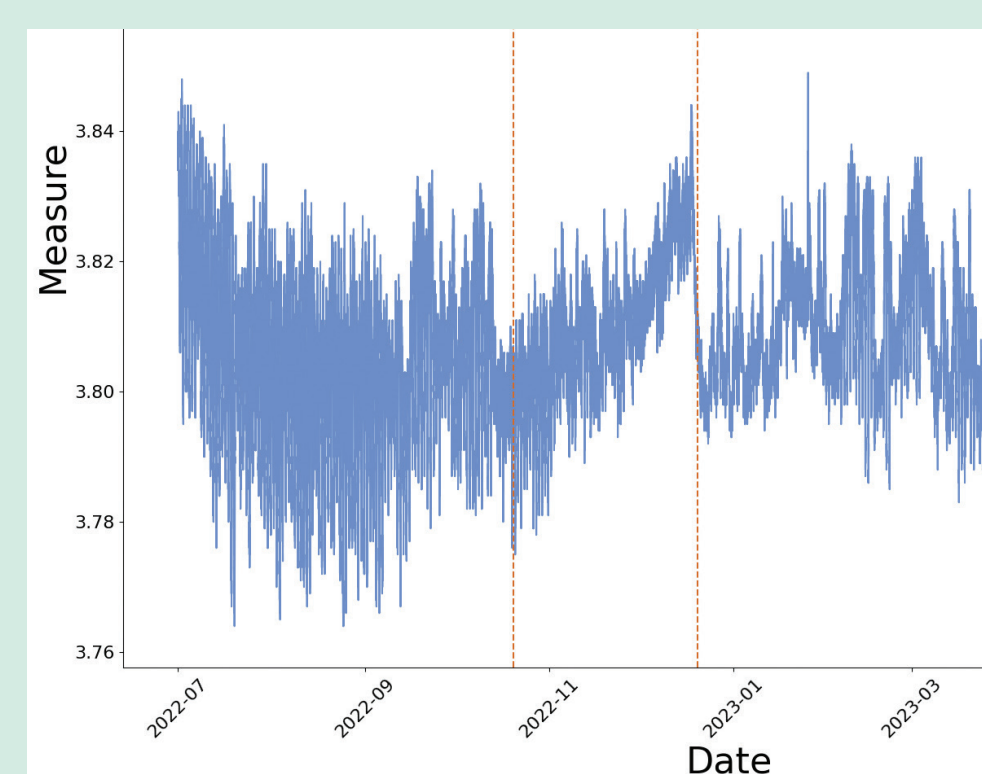
Input data

- Daily cycle due variations in gas consumption
- Setting pressure often modified by operator interventions
- Measurements collected every 5 min and transmitted every day (actualization step d)

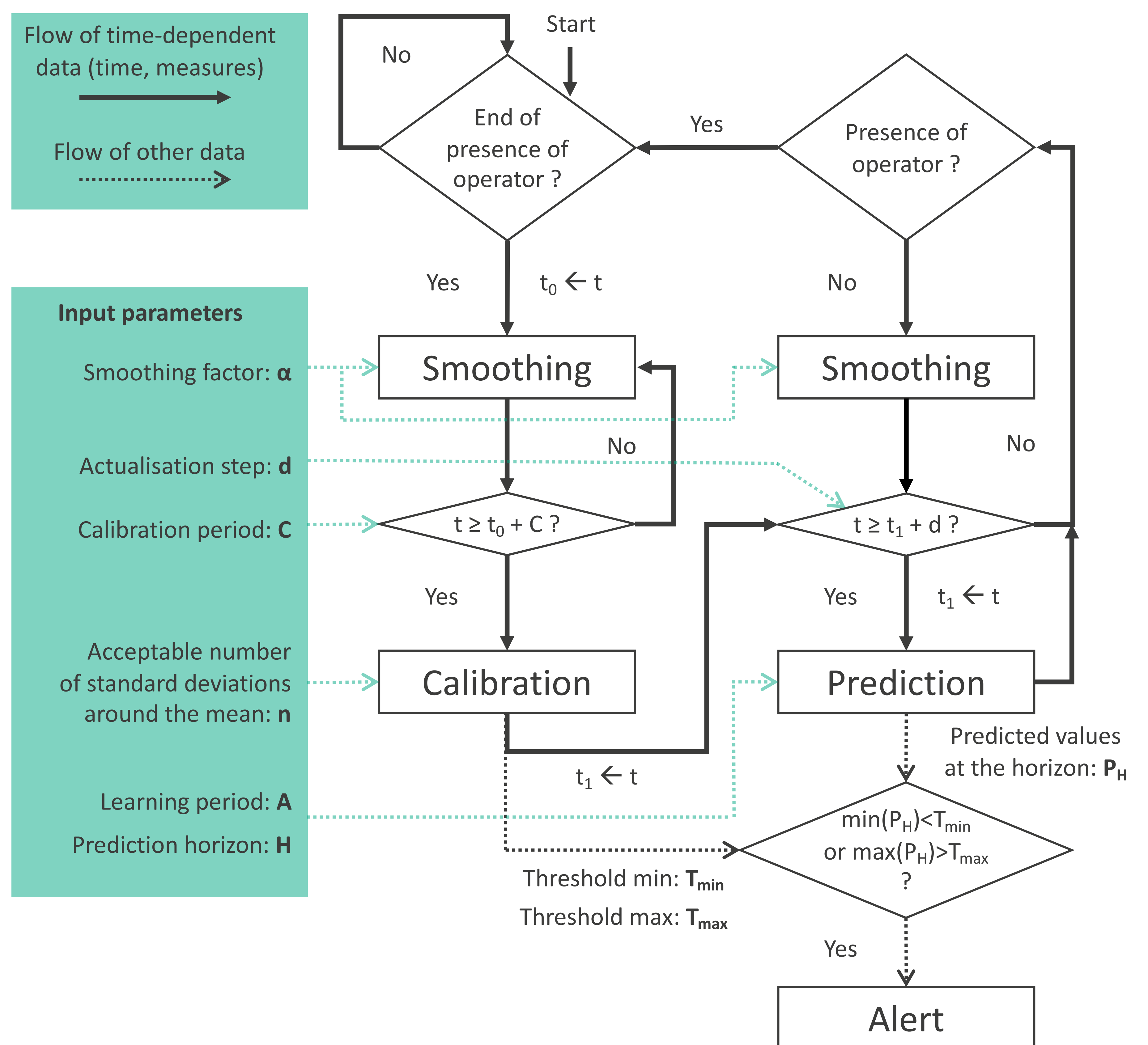
3 days of measurements



1 year of measurements with operator interventions



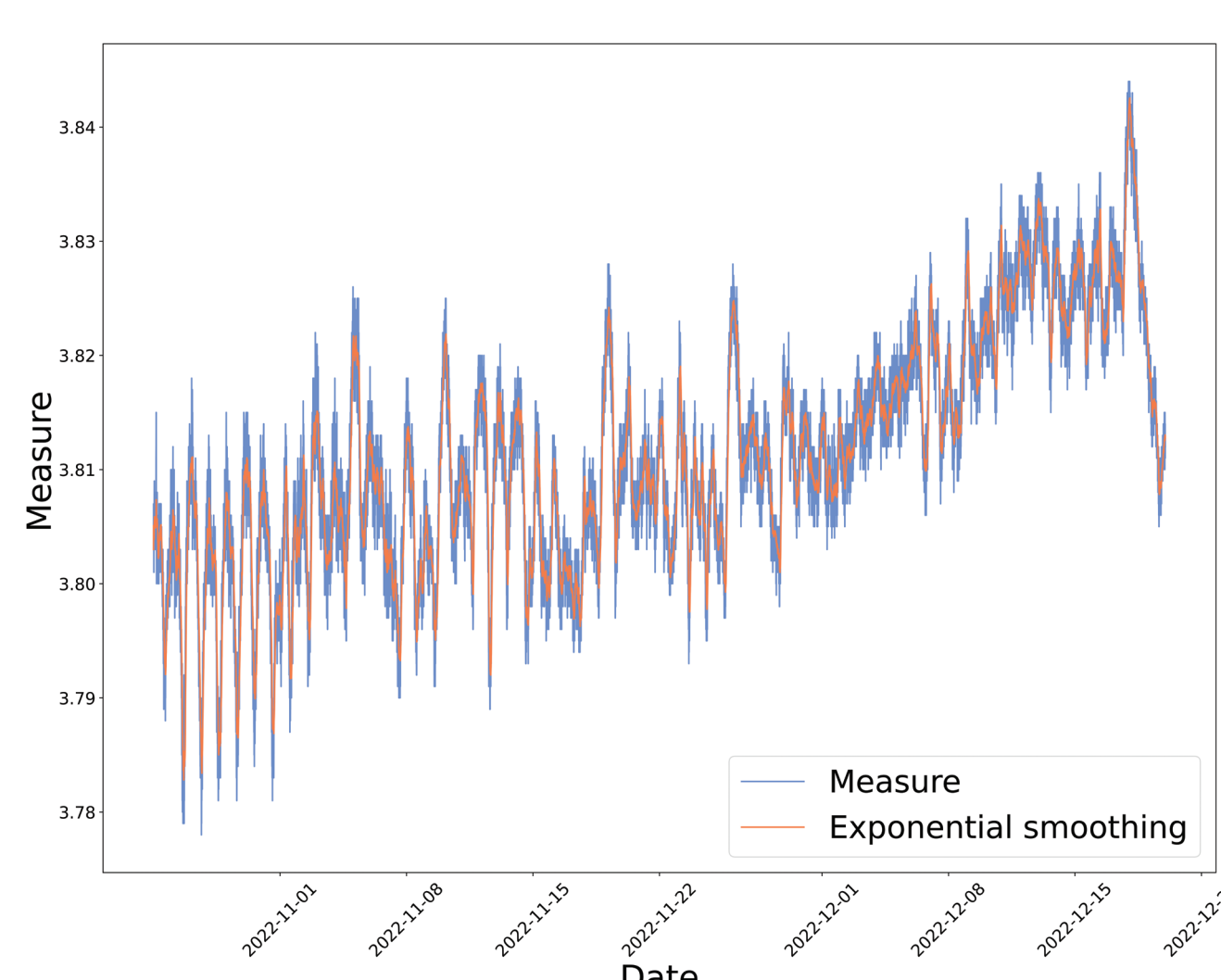
Algorithm for predictive maintenance (patent number FR2213384)



Smoothing

- Pre-processing the measurement data to filter out the random errors due to data quality
- Exponential smoothing: $\hat{y}_t = \alpha \cdot \sum_{j=0}^t (1 - \alpha)^j y_{t-j}$

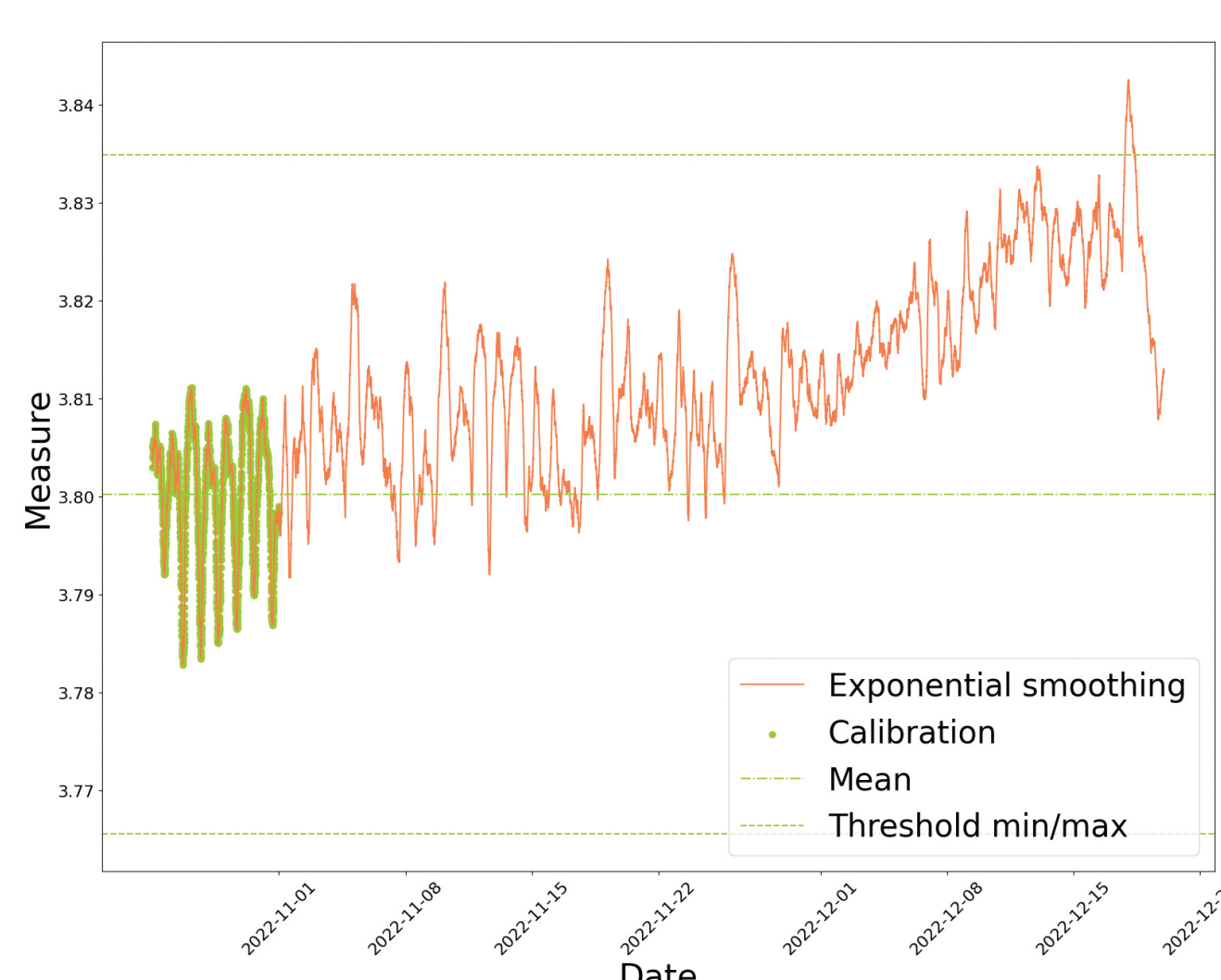
Example of smoothing



Calibration

- Defining automatically the thresholds for which measured drift is not acceptable
- n standard deviations around the mean computed over a calibration period C

Example of calibration



Prediction

- Estimating whether future measurements are likely to exceed a threshold
- Linear regression or AI-based technique (LSTM - RNN) from a learning period A to a horizon H

Example of prediction

