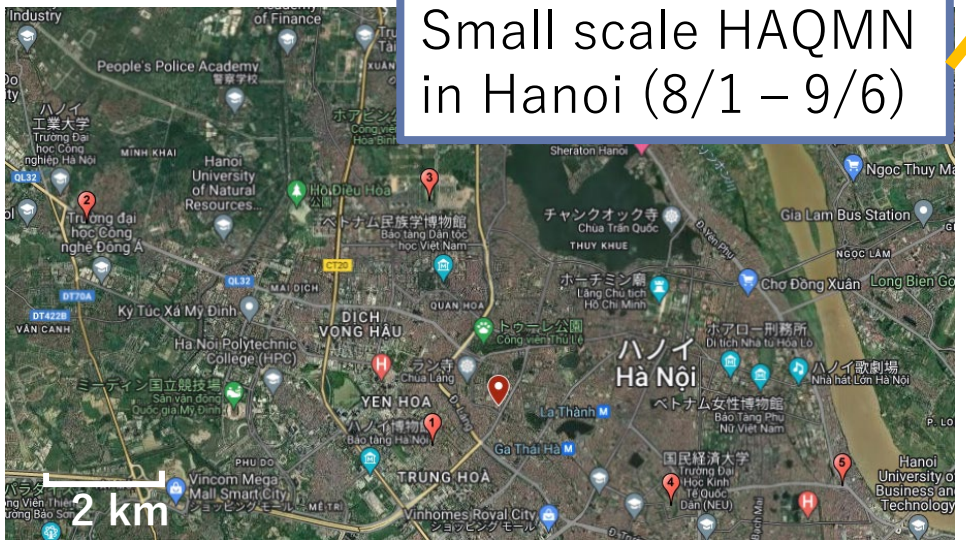
# ADB TA-9608 monitoring and analysis procedure

Launch of Air quality monitoring network in Hanoi

Data providing

Data verification and analysis

Parallel monitoring at IMHEN (7/28-7/31)




Small scale HAQMN in Hanoi (8/1 – 9/6)

Data screening

- Remove noise
- Remove unrealistic data due to the trouble of monitoring

Correlating data

- According to parallel monitoring test, data will be corrected.

Analyzing data

- Relation between wind direction and PM2.5, $O_3$, and $NO_2$
- High PM2.5 events etc.

# Screening of LCS data
## - GBiot Case Study -

Green Blue Corporation

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# Some common data screening methods

**Handling Missing Values**: Environmental sensor data often contain missing values. Dealing with these missing values is crucial to maintain data quality. You can either remove instances with missing values or impute them with alternative values (such as mean, median, or mode).

**Detection and Treatment of Anomalies**: Sensor data might contain anomalies or noise. Use statistical methods or machine learning algorithms to detect anomalies and handle them appropriately. Decide whether to correct or remove anomalies.

**Temporal Data Alignment**: Environmental sensing data are typically collected over time. Incorrect timestamps or sequencing can lead to erroneous analysis results. Organize data in the correct chronological order and rectify any timestamp inaccuracies.

**Duplicate Data Removal**: Duplicate records can introduce biases in analysis results. Identify and remove duplicated data points properly.

**Scaling and Normalization**: To compare data from different sensors, scaling and normalization might be necessary. This process ensures data is on the same scale and facilitates direct comparisons between different data sources.

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# Data Screening Methods for GBiot-FH0 (For $NO_2$)

This figure shows the data flow and data screening method from the time raw data is collected in the LCS until it is sent to the database for display.

GB Server
Stored database

Send raw data from FH0 to GB server every second

LCS:GBiot-FH0

Send data from the stored database to the display database every minute

Every minute, one of the following processes is performed

1. Arithmetic mean
2. Maximum and minimum values
3. N% value (same idea as 98% value for $NO_2$)
4. Nth order correction
5. Programmatic noise data removal

GB Server
Display database



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# Nth-order correction

The following is an example of a first-order correction in Tokyo.

(1)Before adopting the data, parallel measurement of the reference machine and LCSs are performed for about 2 weeks.

(2) Check the correlation between the reference machine and LCSs based on the obtained one-minute data.

(3) Create a linear regression equation and derive the "slope" and "intercept.

(4) Using the primary regression equation with this "slope" and "intercept," the data will be corrected.



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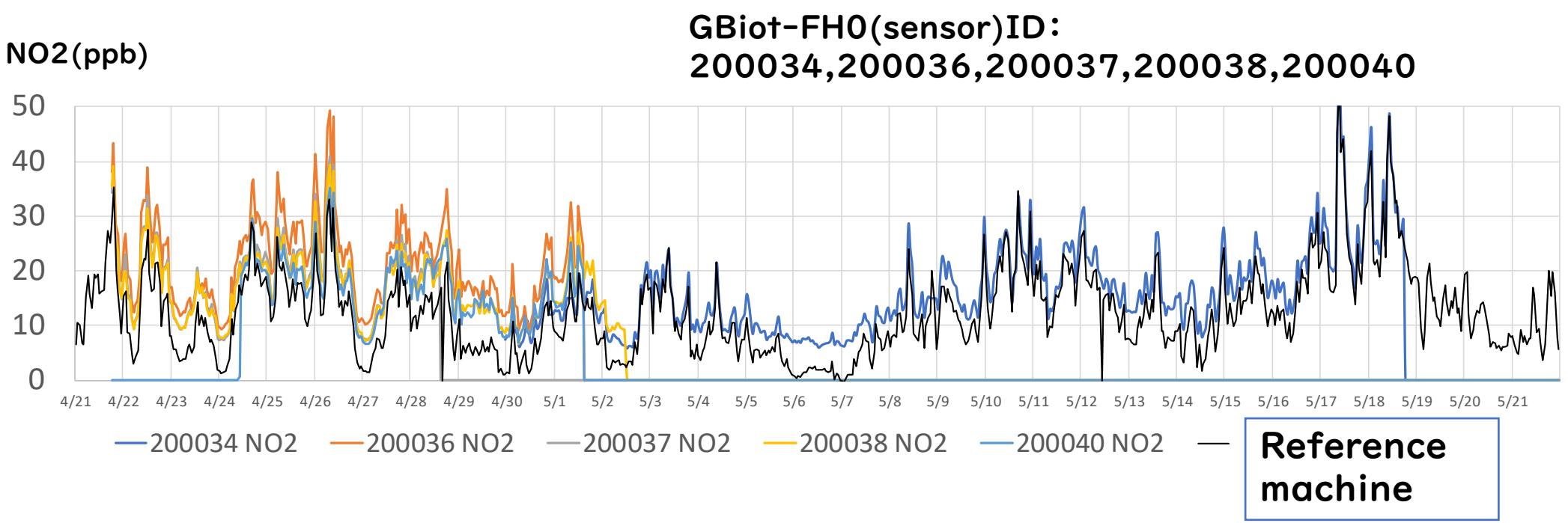
# Nth-order correction

(1) Before adopting the data, parallel measurement of the reference machine and LCSs are performed for about 2 weeks.




- Although the trend of concentration change between the reference machine and each LCS is similar, there is a difference in concentration between them.
- In such cases, LCS data correction is performed.



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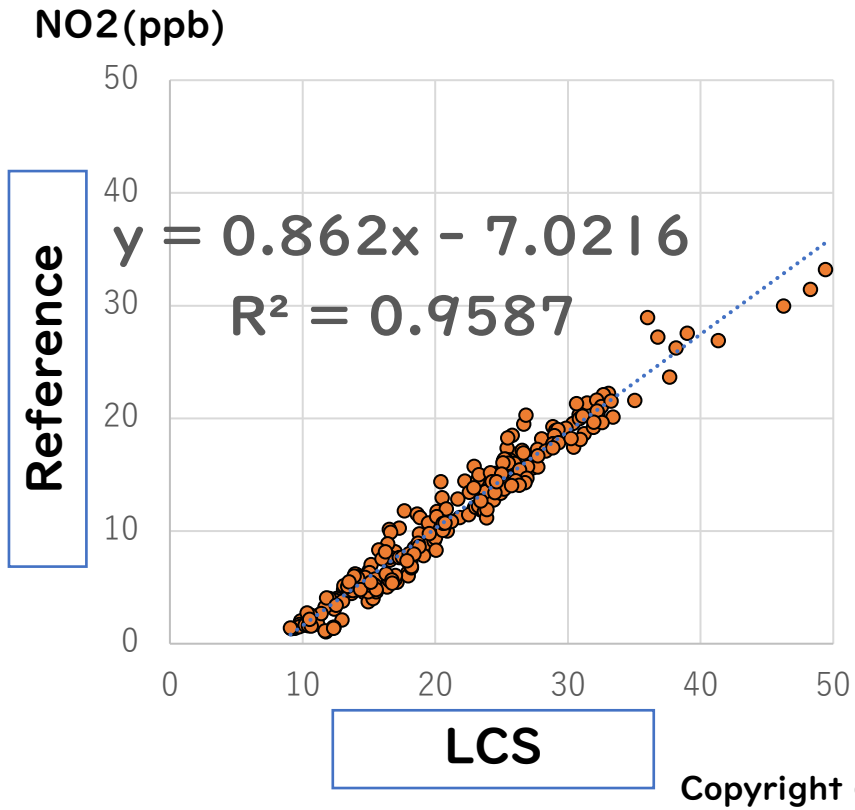
# Nth-order correction

(2) Correlation between the reference machine and each LCS is checked based on the obtained 1-minute value data.
(3) For each LCS, create a first order regression equation to derive the "slope" and "intercept".
(4) The first order regression equation using the "slope" and "intercept" above is used to correct each LCS data.




【Example of GBiot-FH0 (ID200036)】

- Correct the data using the equation
  y = 0.862x + (-7.0216).
- Substitute GBiot data for x.
- y is the corrected value.
- Correct all target data in the same way.

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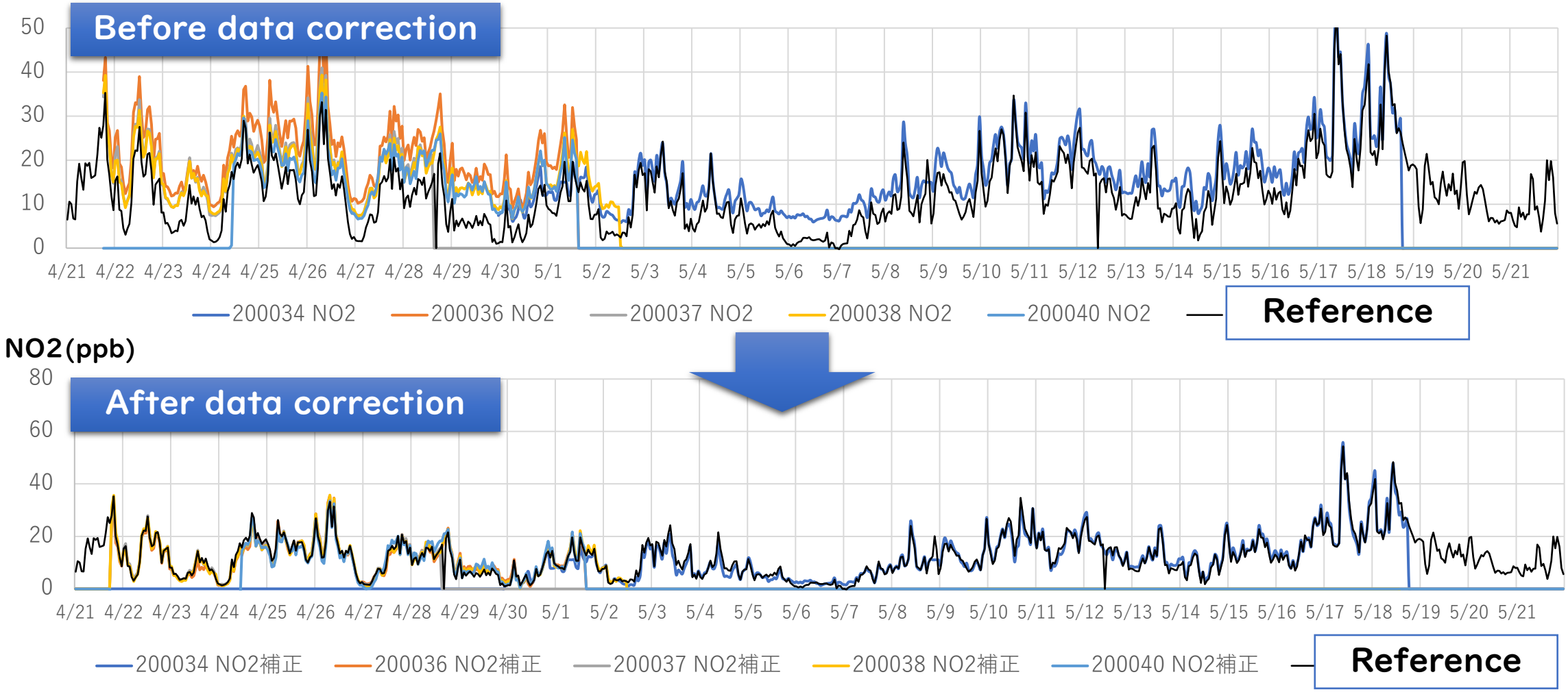
# Nth-order correction

**After correcting the data using the previous procedures, the data from the reference machine and each LCS agreed well as shown in the graph below.**



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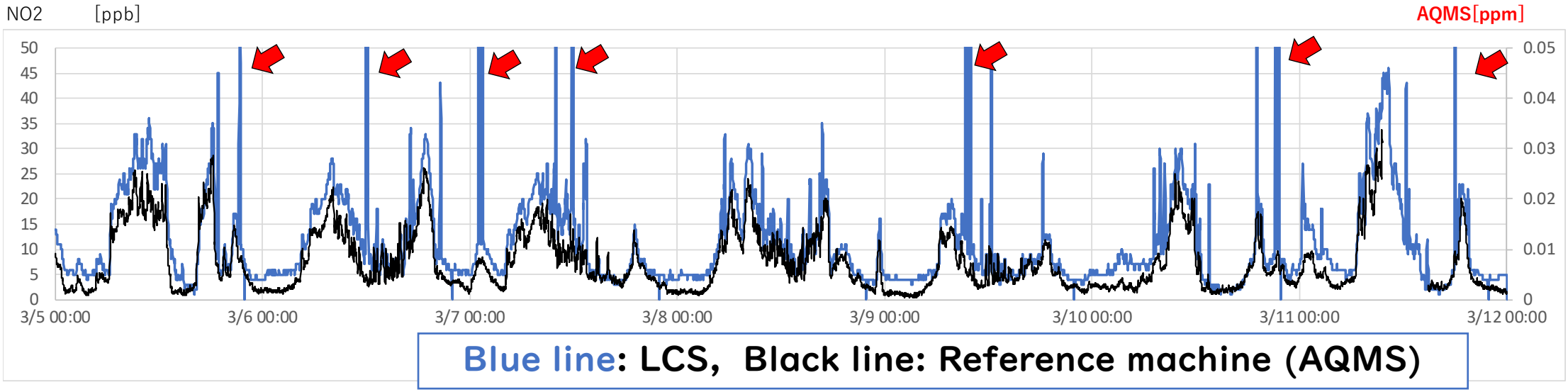
# Noise Data Removal

- Measurements in Myanmar sometimes produced abruptly high LCS data when compared to reference machine. (The red arrows indicate)
- We want to exclude data in which the LCS suddenly became abnormally high, but we do not want to exclude data in which the LCS actually became high.




Blue line: LCS, Black line: Reference machine (AQMS)

Although the case study of noise data removal presented here is not a common one, we will explain it based on an actual case in Myanmar.



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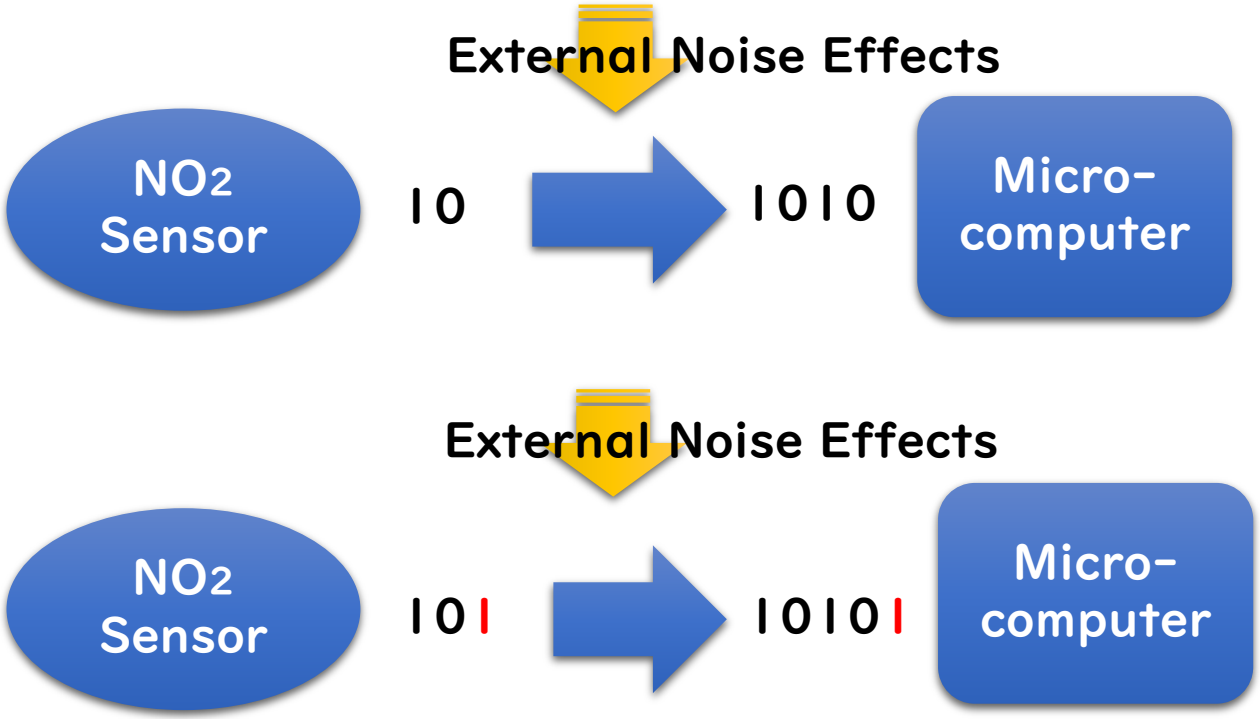
# Noise Data Removal

After analyzing the data just described, the cause of this noise data was identified.

【Cause of abnormal values】
- The cause was found to be that even if the output from the sensor was 10, external noise inside the LCS caused the data to be 1010, although this is rare.

【Countermeasure: Change the program】
- Add an error detection (e.g., 1+0=1 as the total value) code to the data 10 output from the sensor.
- Then, the microcontroller side discards the data caught by the error detection.




The red is the error detection code.
On the sensor side, 1+0=1, whereas on the microcomputer side, 1+0+1+0=2, which is different from 1, the error detection code.
This data is discarded.

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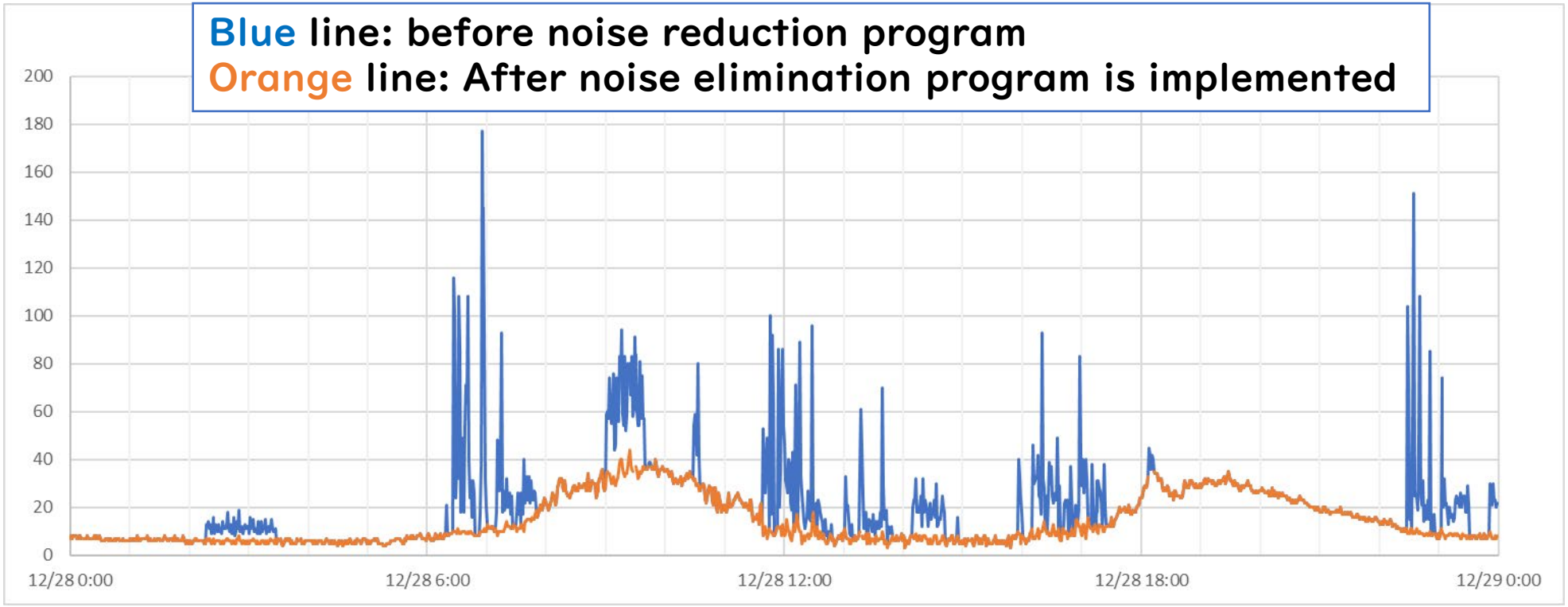
# Noise Data Removal

- Each LCS currently measuring in Vietnam is implemented with a program to remove $NO_2$ noise data, so data anomalies of the type that occurred in Myanmar will not occur.
- However, if other types of abnormal values are newly generated, it will be necessary to take new measures.

NO2(ppb)



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# Current reach and future plans

- For noise data removal, we are working on programmatic automation processes, such as NO2 in this issue, and some of them have already been implemented.

- N-order data correction is currently performed manually, but automatic correction by AI is planned for the future.

- In any case, we are considering a direction that will not impose any burden on LCS users other than the replacement of parts.



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# Thank you for your attention.

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