GRU 24-hour Forecast Report - 西条

$$z_t = \sigma(W_z x_t + U_z h_{t-1} + b_z)$$
$$r_t = \sigma(W_r x_t + U_r h_{t-1} + b_r)$$
$$\tilde{h}_t = \tanh(W_h x_t + U_h (r_t \odot h_{t-1}) + b_h)$$
$$h_t = (1 - z_t) \odot h_{t-1} + z_t \odot \tilde{h}_t$$
$$\hat{y} = W_y h_t + b_y$$
$$\mathcal{L} = \frac{1}{N} \sum_i (y_i - \hat{y}_i)^2$$

x_t: input vector at time t
h_t: hidden state vector at time t
z_t, r_t: update and reset gates
$\tilde{h}_t$: candidate hidden state
σ: sigmoid activation, $\tanh$: hyperbolic tangent
$\mathcal{L}$: mean squared error minimized during training

The Gated Recurrent Unit (GRU) is a type of recurrent neural network designed to capture temporal dependencies in sequential data. It uses two gates—update and reset—to control how information flows through the network, avoiding the vanishing gradient problem of traditional RNNs.

The model is trained by minimizing the mean squared error between predicted and observed values.

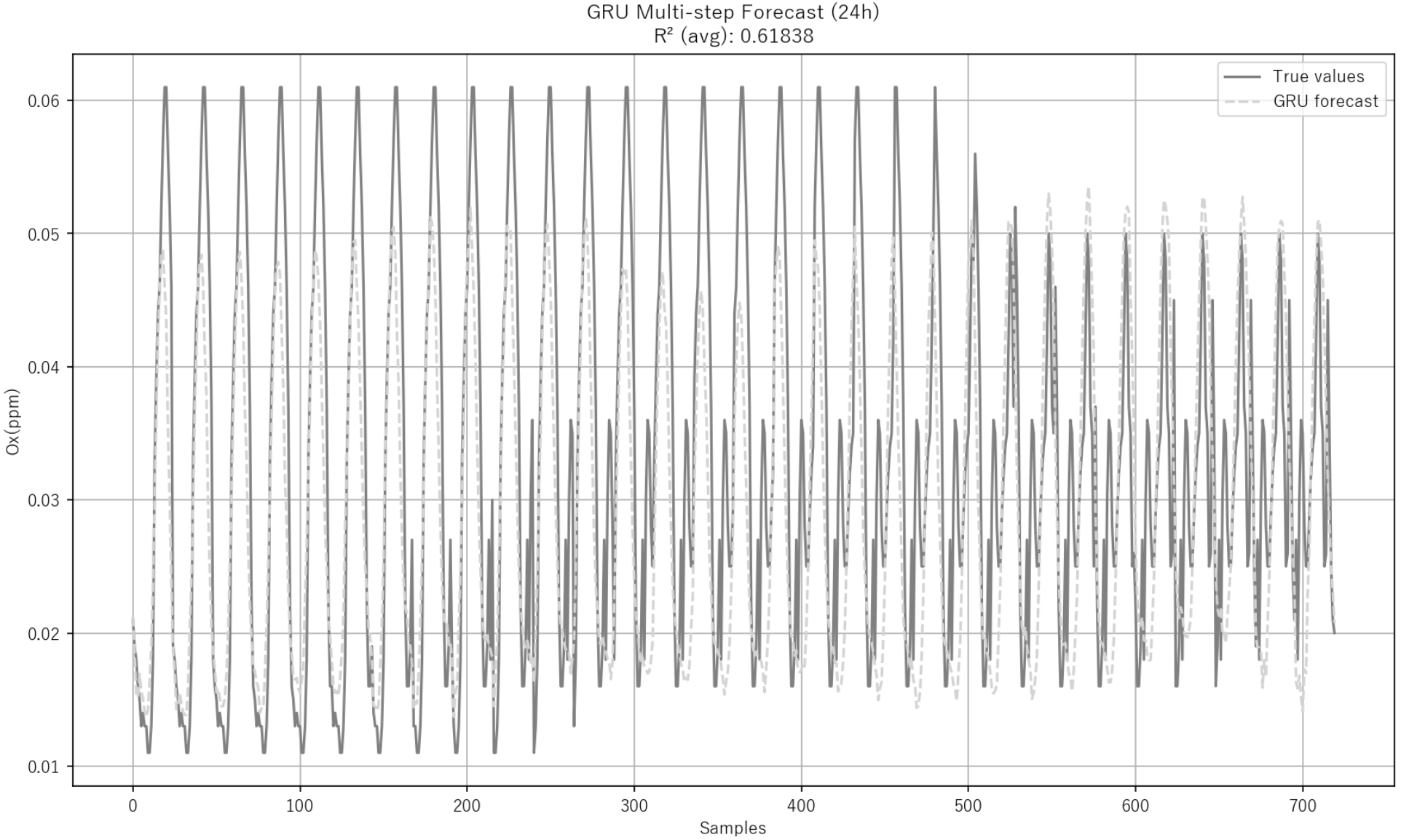
Prefecture code	38
Station code	38206050
Station name	西条
Target item	Ox(ppm)
Train samples	15714
Test samples	6735
Forecast horizon (hours)	24
Model	GRU
Elapsed time	0 min 4 sec
Number of features used	28
Residuals mean	0.000174
Residuals median	-0.000507
Residuals mode	-0.001265

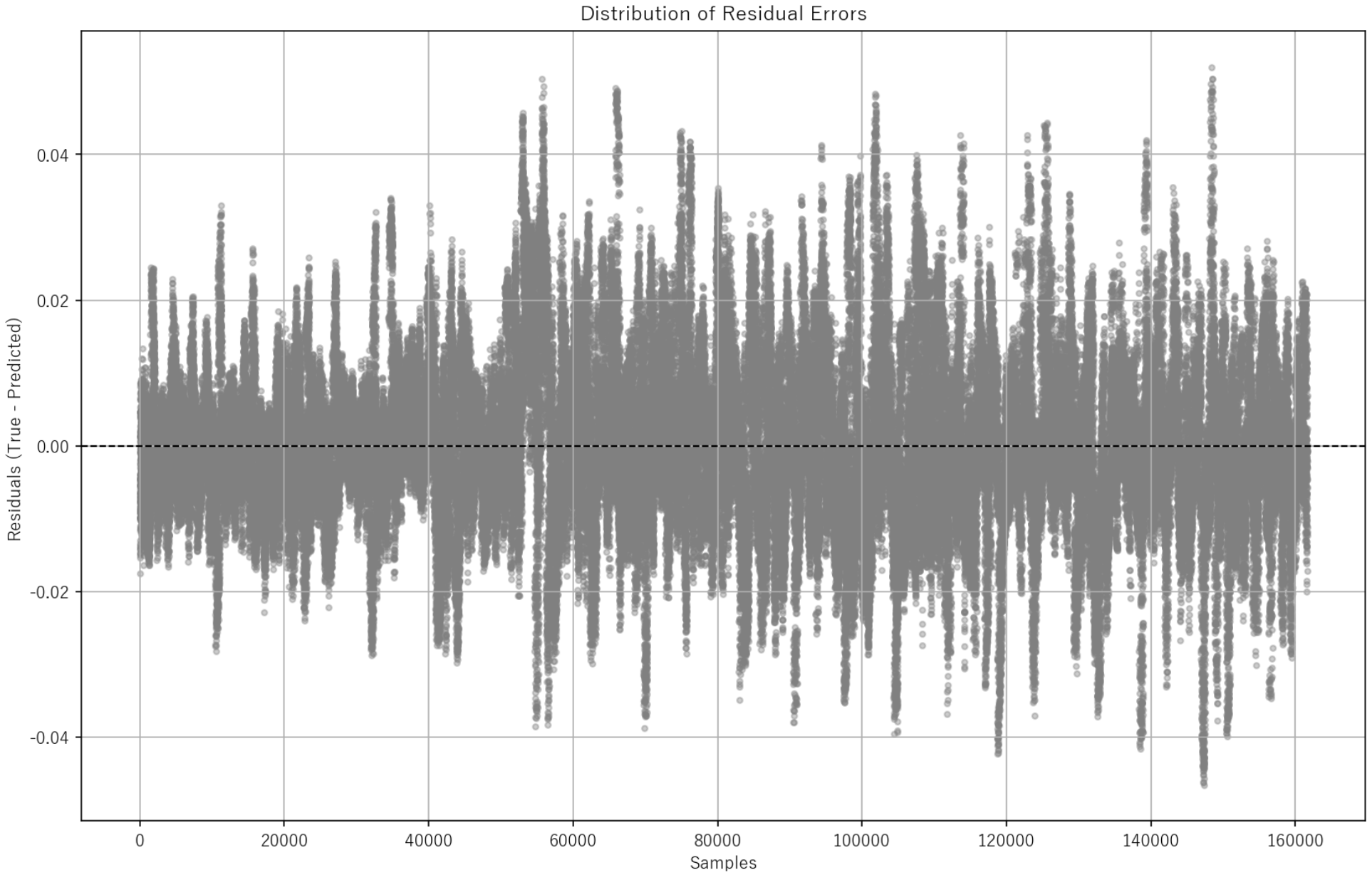
Features used for prediction

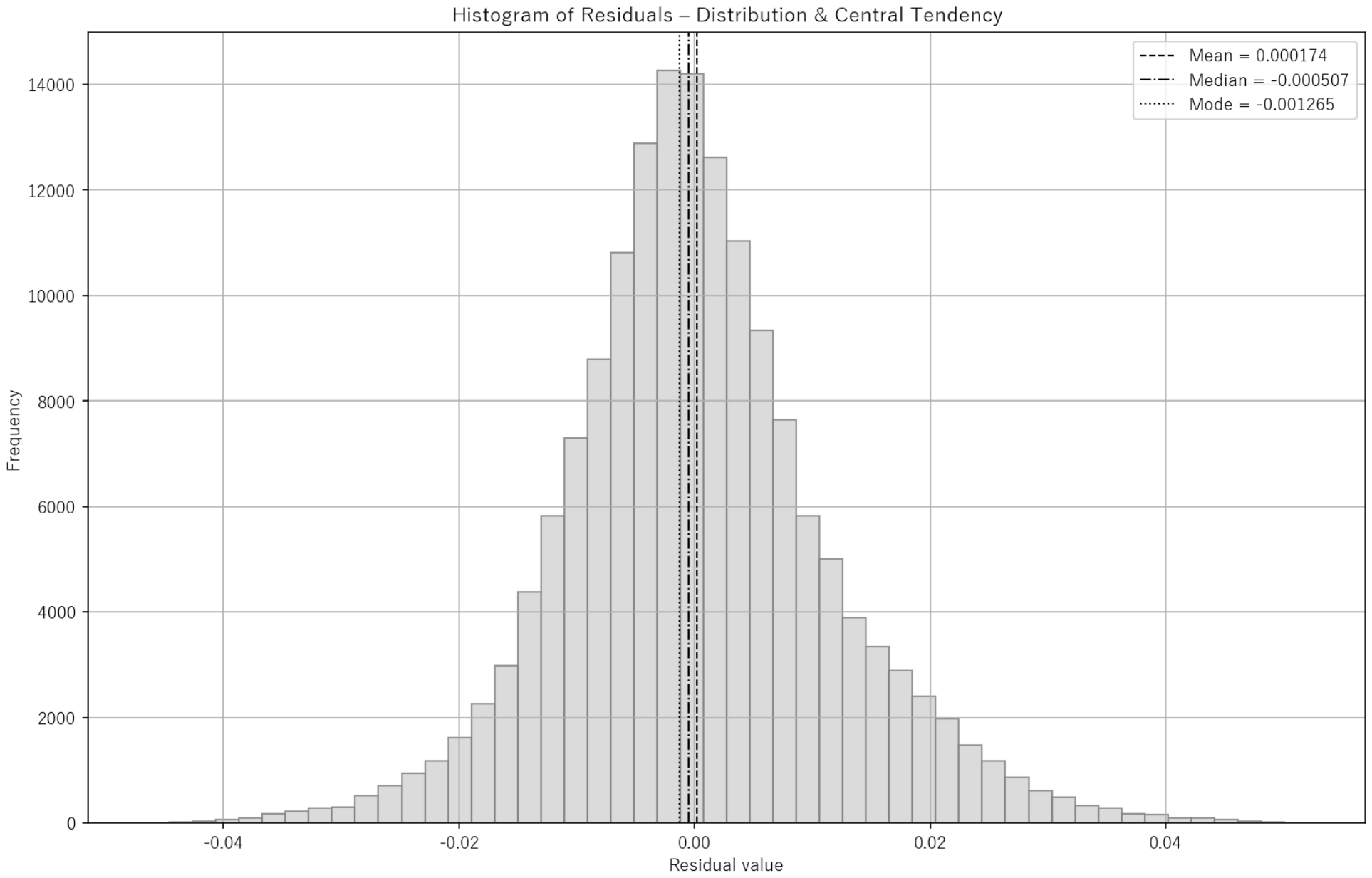
NO(ppm)	NO2(ppm)	U	V	Ox(ppm)_roll_mean_3
Ox(ppm)_roll_std_6	NO(ppm)_roll_mean_3	NO(ppm)_roll_std_6	NO2(ppm)_roll_mean_3	NO2(ppm)_roll_std_6
U_roll_mean_3	U_roll_std_6	V_roll_mean_3	V_roll_std_6	Ox(ppm)_diff_1
Ox(ppm)_diff_3	NO(ppm)_diff_1	NO(ppm)_diff_3	NO2(ppm)_diff_1	NO2(ppm)_diff_3
U_diff_1	U_diff_3	V_diff_1	V_diff_3	hour_sin
hour_cos	dayofweek	is_weekend		

Model accuracy

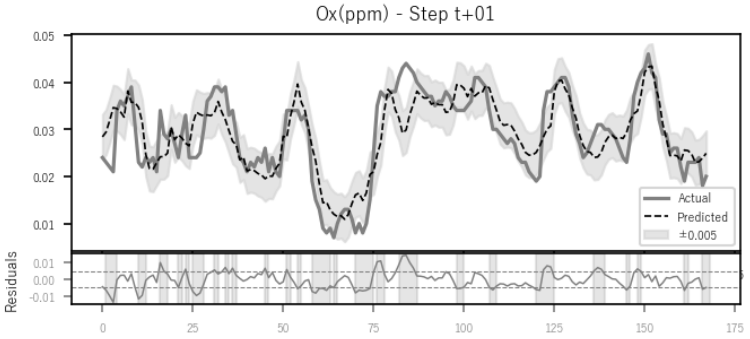
Target	R^2	MAE	RMSE
Ox(ppm)_t+01	0.8188	0.0058	0.0078
Ox(ppm)_t+02	0.7705	0.0065	0.0087
Ox(ppm)_t+03	0.7351	0.0070	0.0094
Ox(ppm)_t+04	0.7057	0.0074	0.0099
Ox(ppm)_t+05	0.6775	0.0078	0.0104
Ox(ppm)_t+06	0.6614	0.0080	0.0106
Ox(ppm)_t+07	0.6421	0.0083	0.0109
Ox(ppm)_t+08	0.6267	0.0084	0.0112
Ox(ppm)_t+09	0.6090	0.0086	0.0114
Ox(ppm)_t+10	0.6036	0.0087	0.0115
Ox(ppm)_t+11	0.5949	0.0088	0.0116
Ox(ppm)_t+12	0.5874	0.0089	0.0117
Ox(ppm)_t+13	0.5884	0.0089	0.0117
Ox(ppm)_t+14	0.5864	0.0089	0.0117
Ox(ppm)_t+15	0.5803	0.0090	0.0118
Ox(ppm)_t+16	0.5801	0.0090	0.0118
Ox(ppm)_t+17	0.5760	0.0090	0.0119
Ox(ppm)_t+18	0.5733	0.0091	0.0119
Ox(ppm)_t+19	0.5695	0.0091	0.0120
Ox(ppm)_t+20	0.5628	0.0093	0.0121
Ox(ppm)_t+21	0.5591	0.0093	0.0121
Ox(ppm)_t+22	0.5524	0.0093	0.0122
Ox(ppm)_t+23	0.5451	0.0094	0.0123
Ox(ppm)_t+24	0.5351	0.0095	0.0124

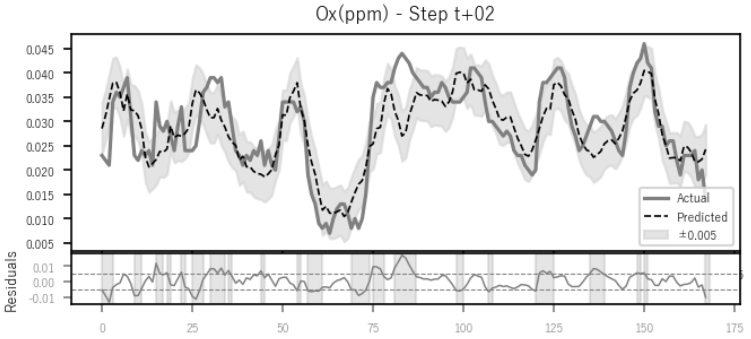

GRU Multi-step Forecast (24h)
R² (avg): 0.61838
True values
GRU forecast
Ox(ppm)
0.06
0.05
0.04
0.03
0.02
0.01
0
100
200
300
400
500
600
700
Samples

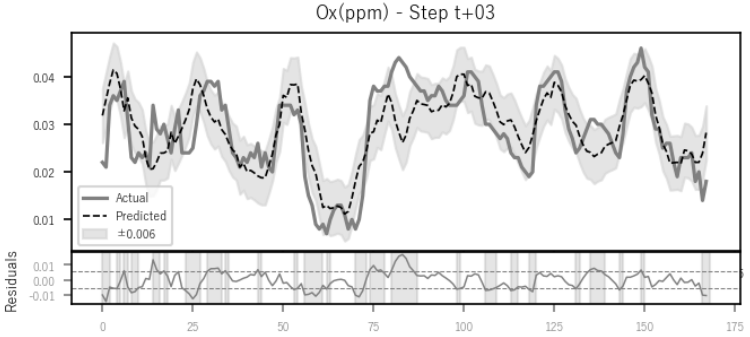

Distribution of Residual Errors
Residuals (True - Predicted)
0.04
0.02
0.00
-0.02
-0.04
0
20000
40000
60000
80000
100000
120000
140000
160000
Samples

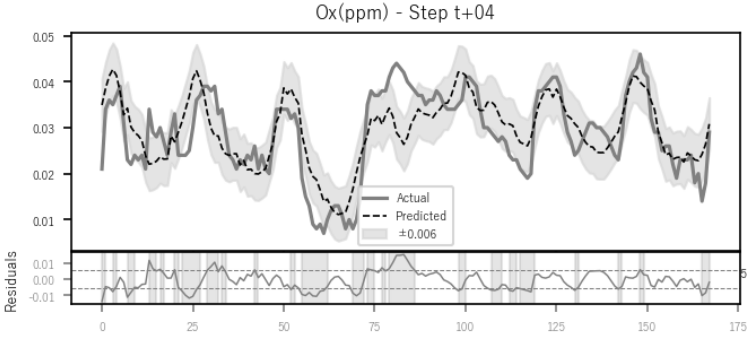

Histogram of Residuals – Distribution & Central Tendency
Mean = 0.000174
Median = -0.000507
Mode = -0.001265
Frequency
14000
12000
10000
8000
6000
4000
2000
0
-0.04
-0.02
0.00
0.02
0.04
Residual value

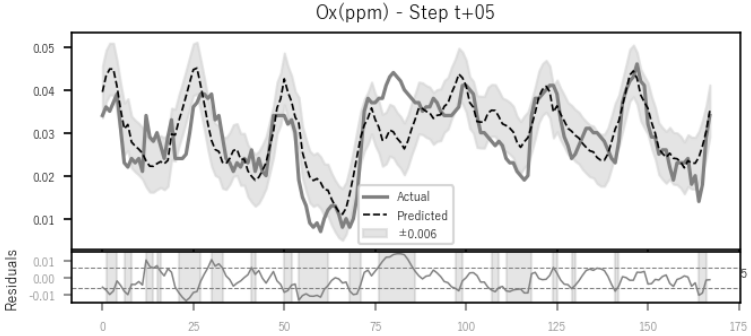
Comparison between actual and predicted values
with ± Standard Deviation Bands

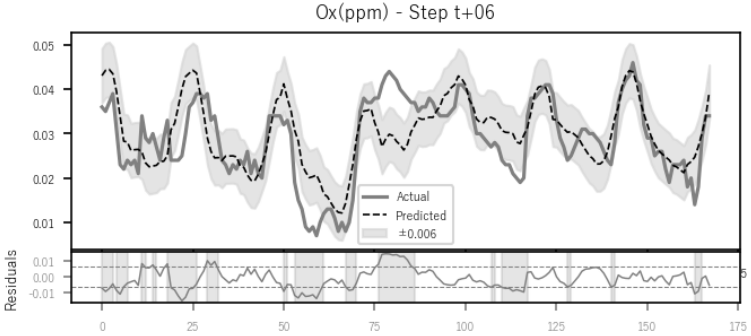




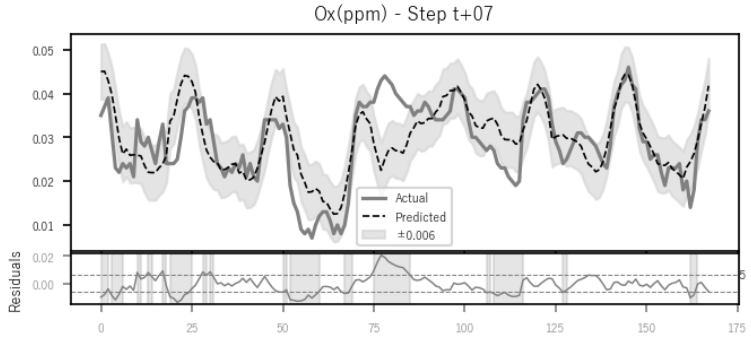


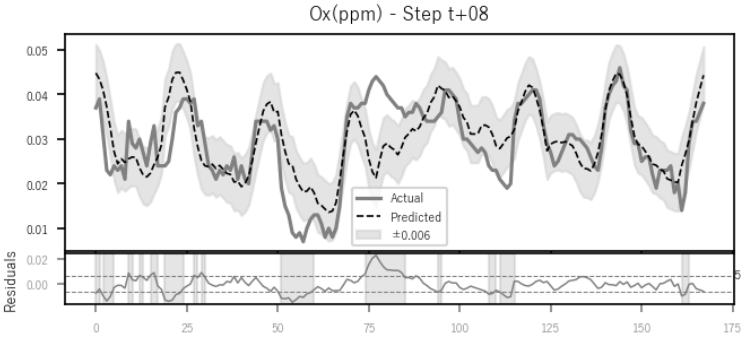


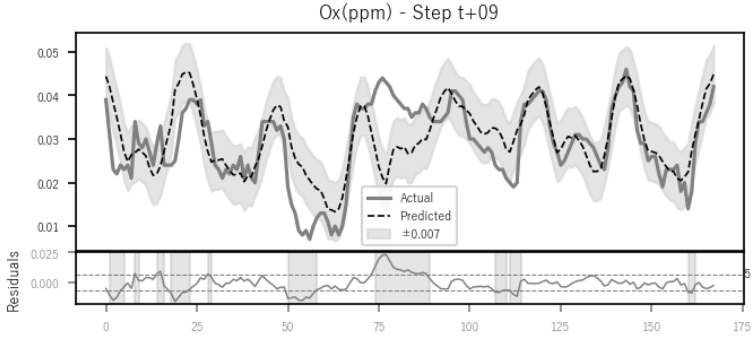


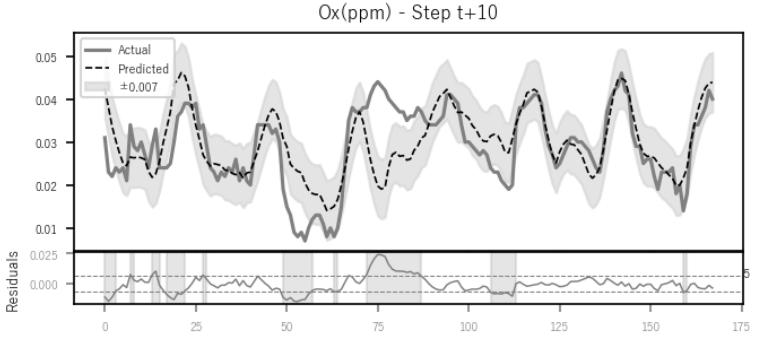


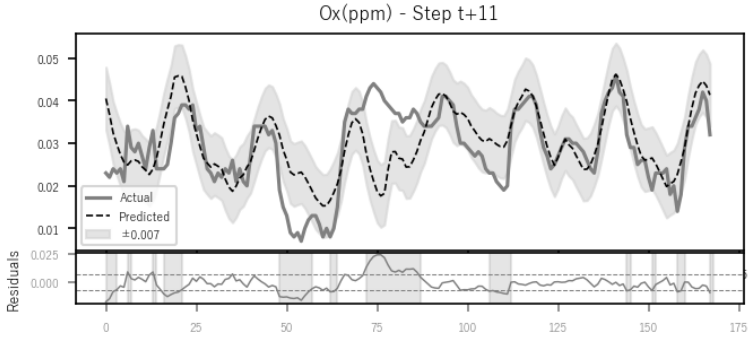
Comparison between actual and predicted values
with ± Standard Deviation Bands

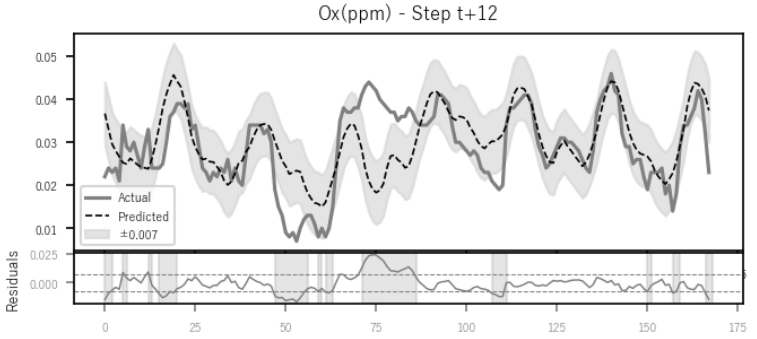




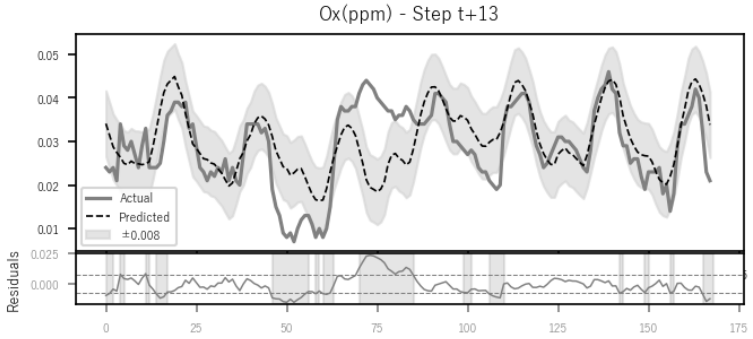


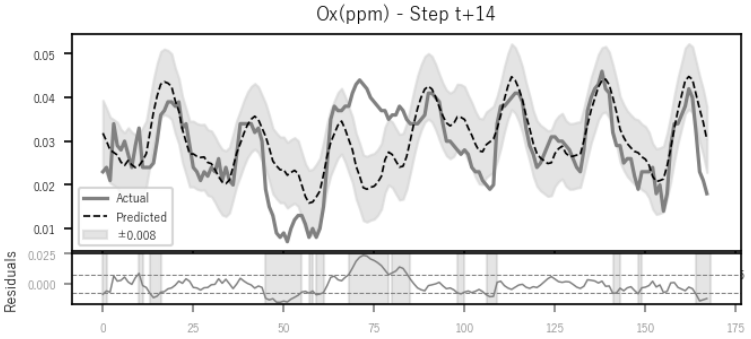


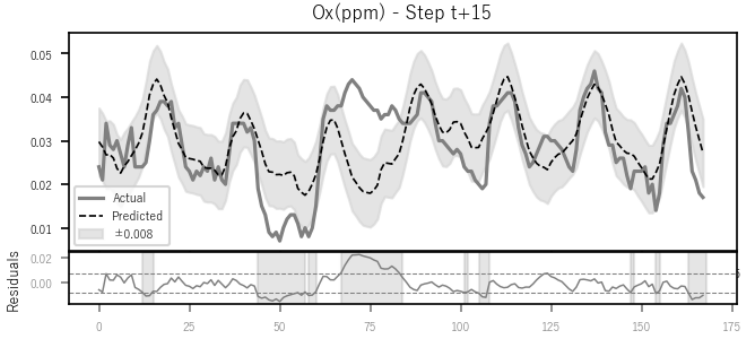


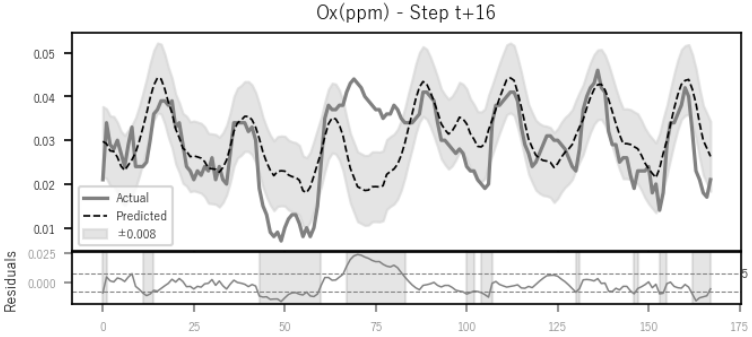


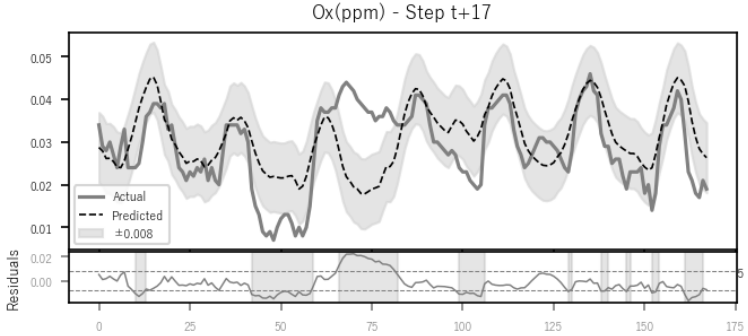
Comparison between actual and predicted values
with ± Standard Deviation Bands

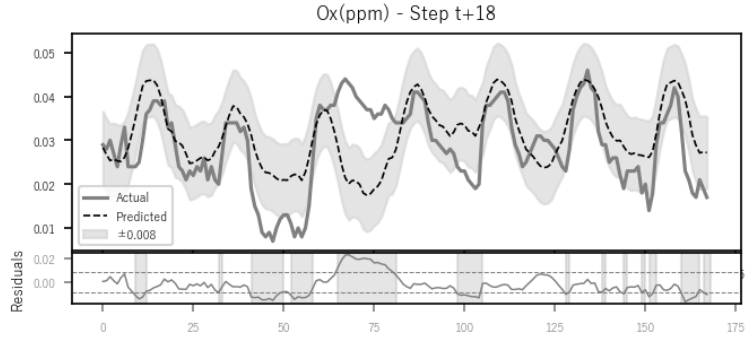












Comparison between actual and predicted values
with ± Standard Deviation Bands