MLP 24-hour Forecast Report - 西条

$$h^{(1)} = \sigma(W^{(1)}x + b^{(1)})$$
$$h^{(l)} = \sigma(W^{(l)}h^{(l-1)} + b^{(l)})$$
$$\hat{y} = W^{(L)}h^{(L-1)} + b^{(L)}$$

$$\mathcal{L} = \frac{1}{N}\sum_{i=1}^{N}(y_i - \hat{y}_i)^2$$

x: input feature vector
$h^{(l)}$: hidden layer activations at layer l
$W^{(l)}, b^{(l)}$: learnable weights and biases at layer l
σ: non-linear activation (ReLU, tanh, etc.)
$\hat{y}$: output vector (multi-step predictions)
$\mathcal{L}$: mean squared error minimized during training

The Multi-Layer Perceptron (MLP) is a feedforward neural network composed of an input layer, one or more hidden layers, and an output layer.

Each layer applies a linear transformation followed by a non-linear activation, allowing the network to model complex, non-linear relationships.

In this application, the MLP outputs 24 simultaneous predictions (multi-output) corresponding to the next 24 hours of Ox(ppm) concentrations.

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

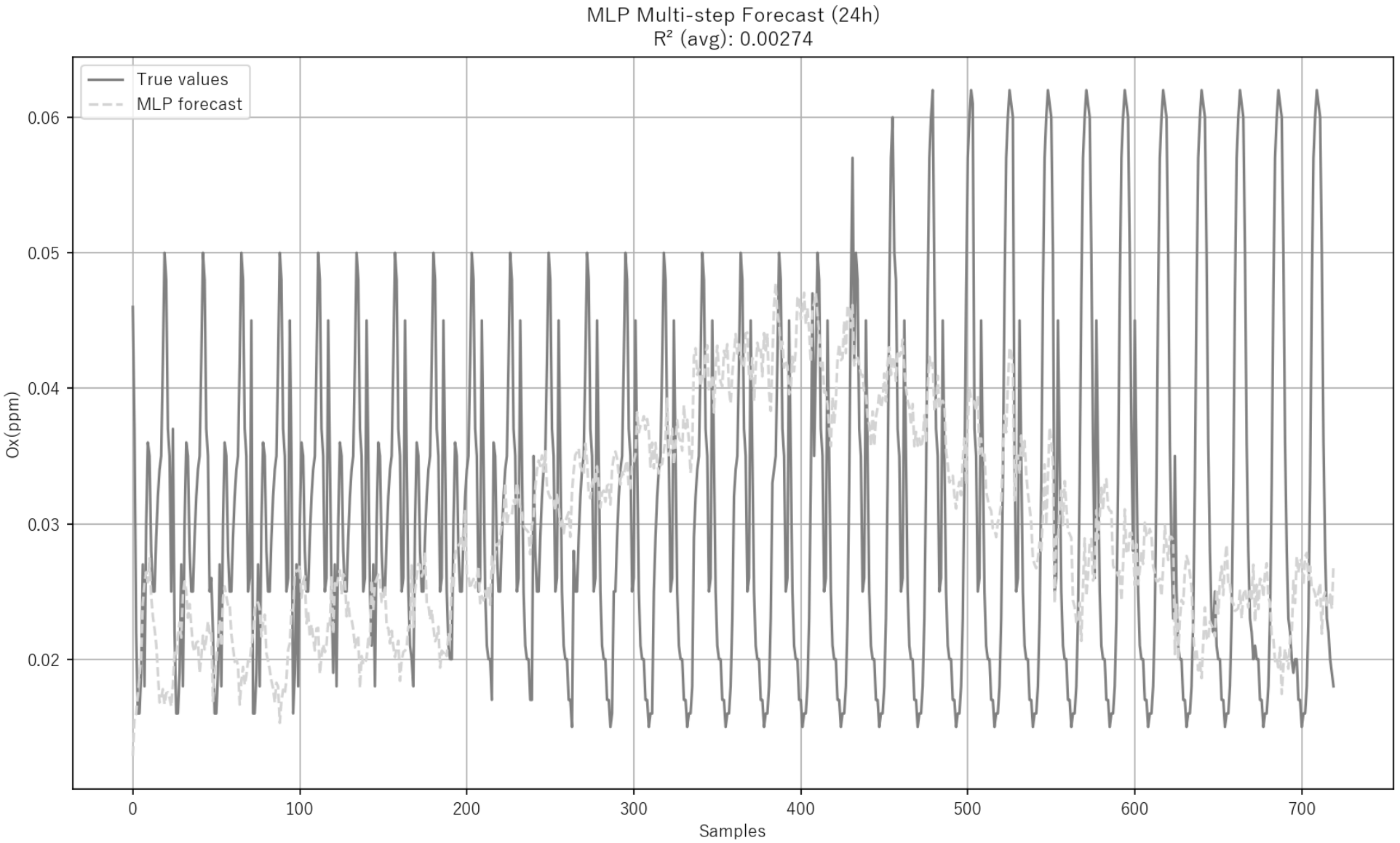
Prefecture code	38
Station code	38206050
Station name	西条
Target item	Ox(ppm)
Number of data points in the train set	15731
Number of data points in the test set	6742
Forecast horizon (hours)	24
Model	MLP
Elapsed time	0 min 5 sec
Number of features used	28
Residuals mean	0.002129
Residuals median	0.000244
Residuals mode	-0.008096

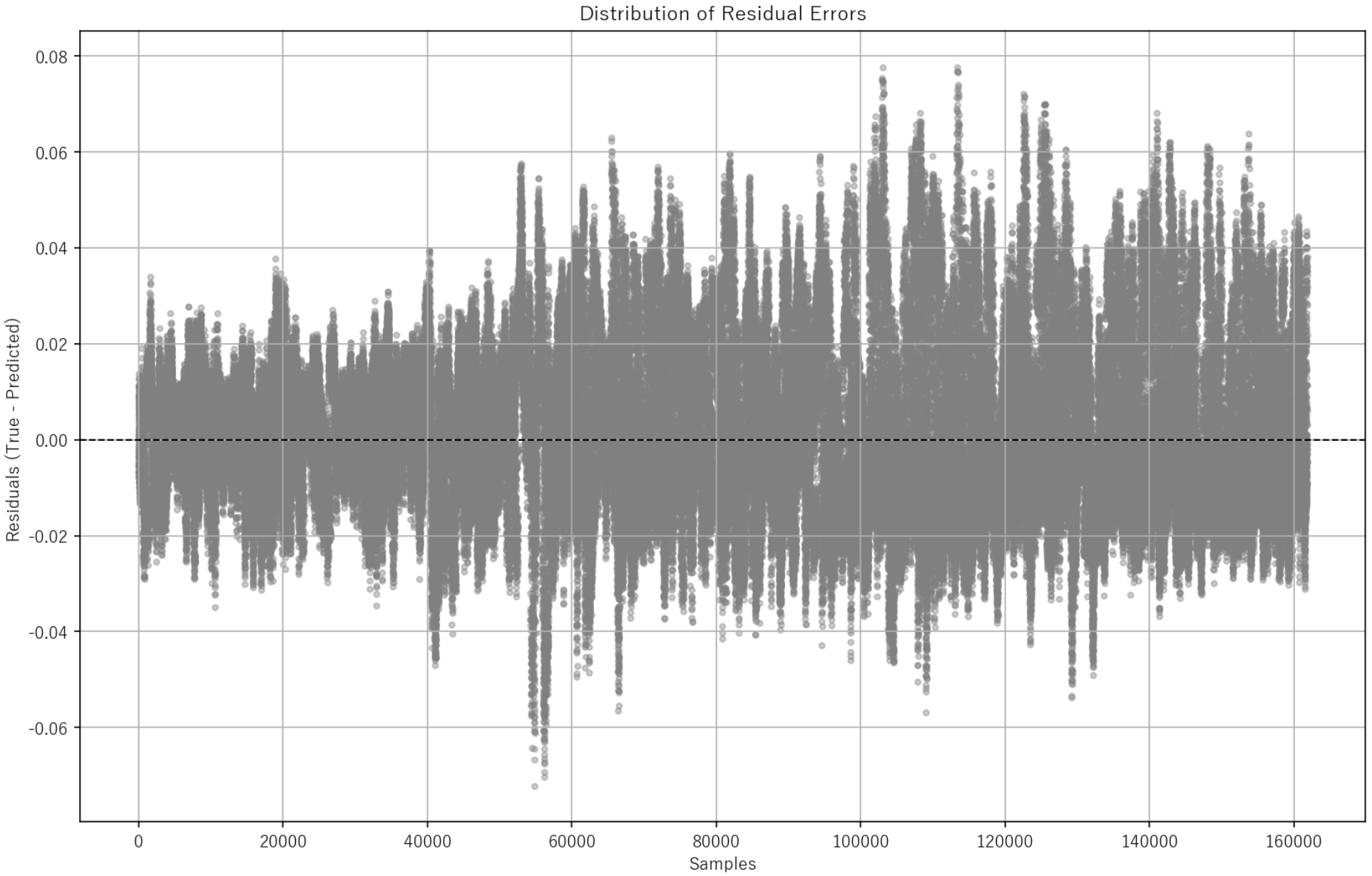
Features used for prediction

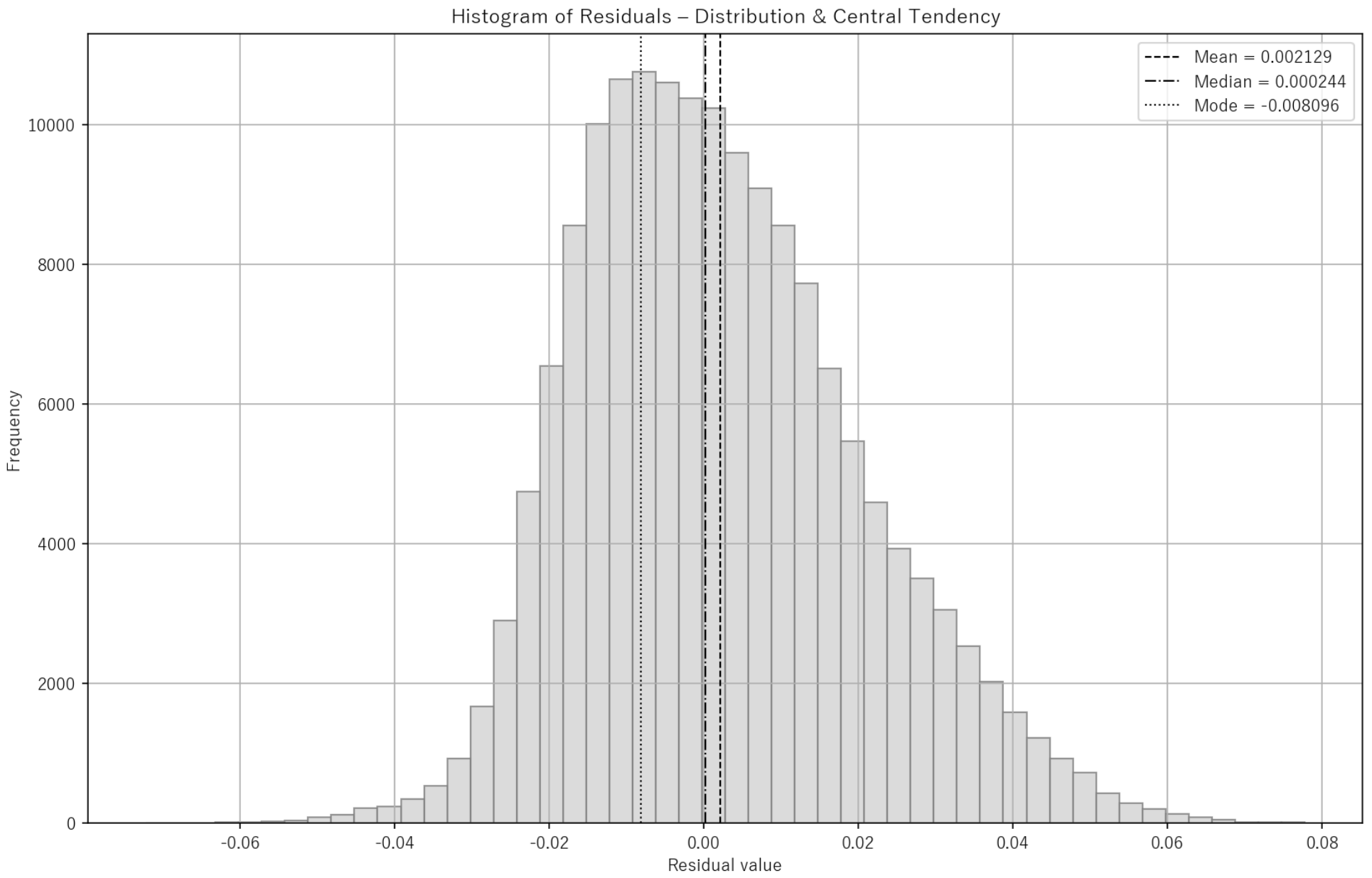
NO(ppm)	NO2(ppm)	U	V	Ox(ppm)_roll_mean_3
Ox(ppm)_roll_std_6	NO(ppm)_roll_mean_3	NO(ppm)_roll_std_6	NO2(ppm)_roll_mean_3	NO2(ppm)_roll_std_6
U_roll_mean_3	U_roll_std_6	V_roll_mean_3	V_roll_std_6	Ox(ppm)_diff_1
Ox(ppm)_diff_3	NO(ppm)_diff_1	NO(ppm)_diff_3	NO2(ppm)_diff_1	NO2(ppm)_diff_3
U_diff_1	U_diff_3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

Model accuracy

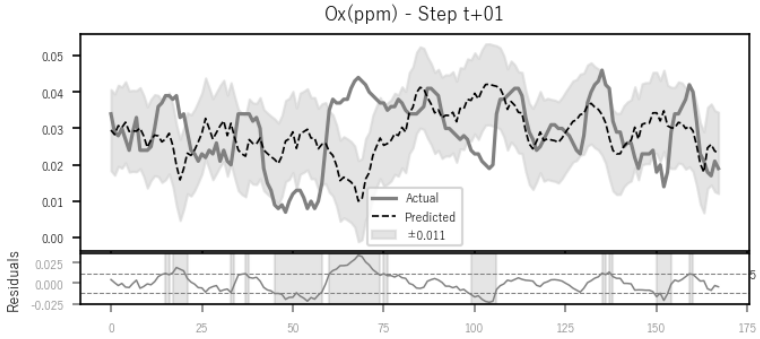
Target	R^2	MAE	RMSE
Ox(ppm)_t+01	0.1929	0.0129	0.0164
Ox(ppm)_t+02	0.2360	0.0126	0.0159
Ox(ppm)_t+03	0.2905	0.0121	0.0154
Ox(ppm)_t+04	0.2767	0.0123	0.0155
Ox(ppm)_t+05	0.2709	0.0123	0.0156
Ox(ppm)_t+06	0.2435	0.0124	0.0159
Ox(ppm)_t+07	0.1953	0.0128	0.0164
Ox(ppm)_t+08	0.1824	0.0130	0.0165
Ox(ppm)_t+09	0.0870	0.0138	0.0174
Ox(ppm)_t+10	0.0652	0.0141	0.0176
Ox(ppm)_t+11	-0.0576	0.0151	0.0188
Ox(ppm)_t+12	-0.0835	0.0152	0.0190
Ox(ppm)_t+13	-0.0908	0.0152	0.0191
Ox(ppm)_t+14	-0.1646	0.0157	0.0197
Ox(ppm)_t+15	-0.2022	0.0160	0.0200
Ox(ppm)_t+16	-0.2031	0.0160	0.0200
Ox(ppm)_t+17	-0.2983	0.0166	0.0208
Ox(ppm)_t+18	-0.2308	0.0163	0.0203
Ox(ppm)_t+19	-0.2285	0.0163	0.0202
Ox(ppm)_t+20	-0.2141	0.0161	0.0201
Ox(ppm)_t+21	-0.1659	0.0159	0.0197
Ox(ppm)_t+22	-0.0834	0.0153	0.0190
Ox(ppm)_t+23	0.0240	0.0144	0.0180
Ox(ppm)_t+24	0.0241	0.0145	0.0180

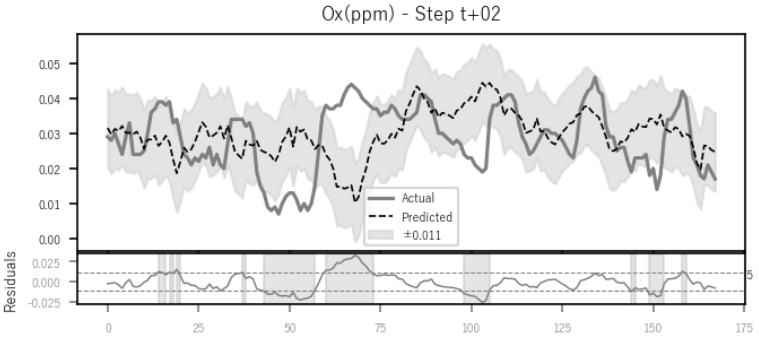

MLP Multi-step Forecast (24h)
R² (avg): 0.00274
True values
MLP forecast
Ox(ppm)
0.06
0.05
0.04
0.03
0.02
0
100
200
300
400
500
600
700
Samples

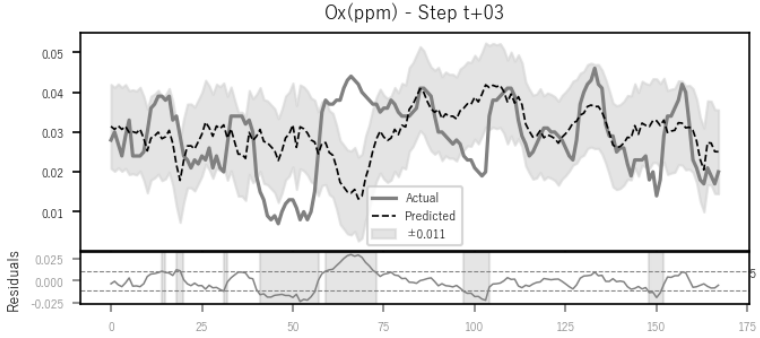

Distribution of Residual Errors
Residuals (True - Predicted)
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
0
20000
40000
60000
80000
100000
120000
140000
160000
Samples

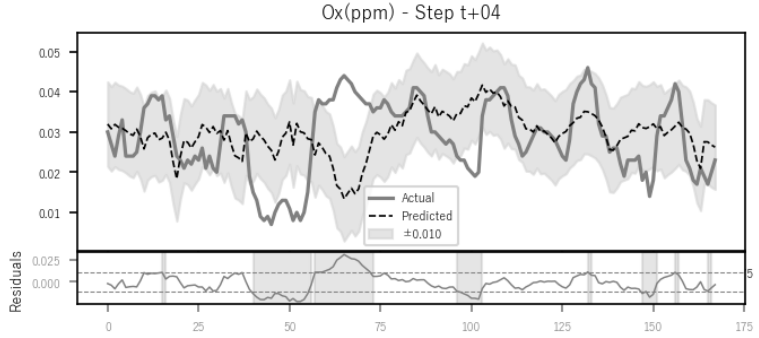

Histogram of Residuals – Distribution & Central Tendency
Mean = 0.002129
Median = 0.000244
Mode = -0.008096
Frequency
Residual value
0
2000
4000
6000
8000
10000
-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06
0.08

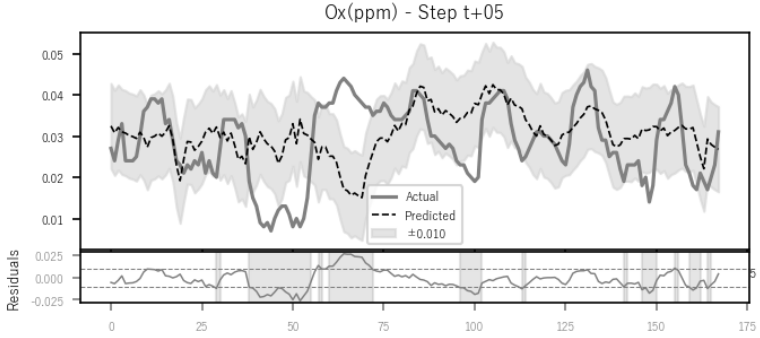
Comparison between actual and predicted values
with ± Standard Deviation Bands

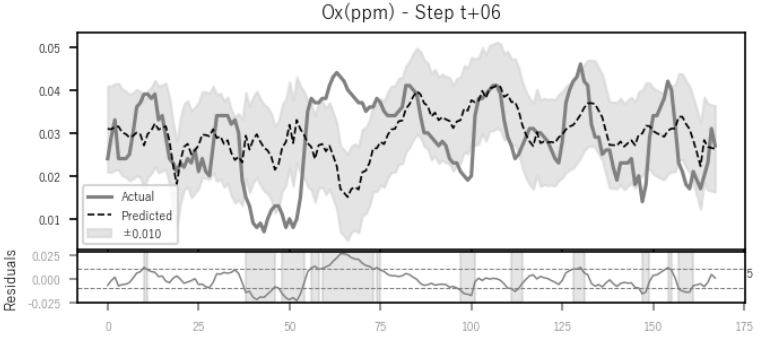












Comparison between actual and predicted values
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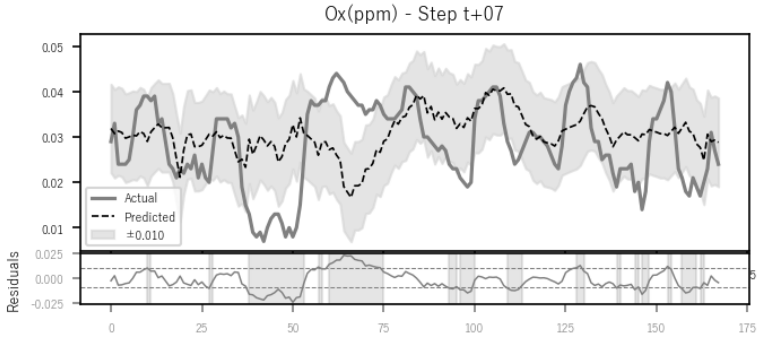

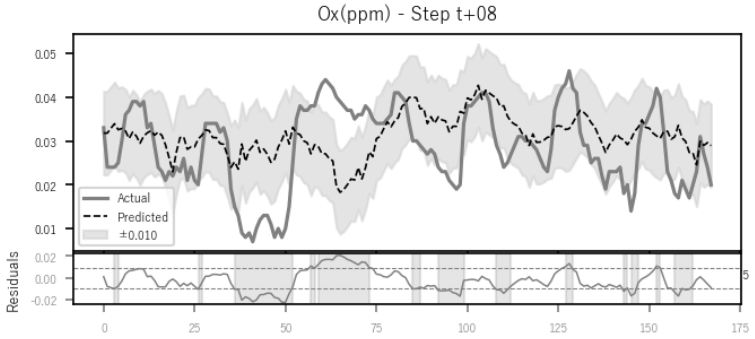

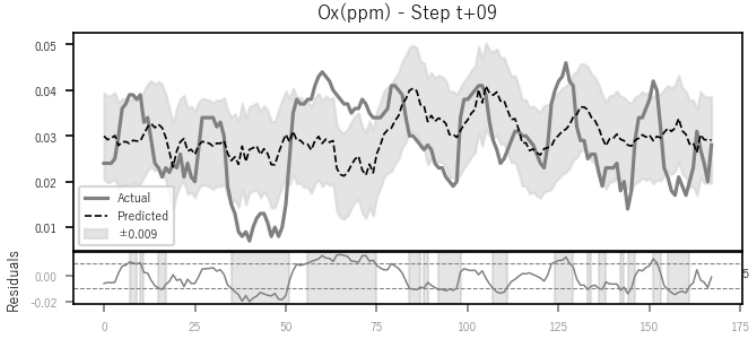

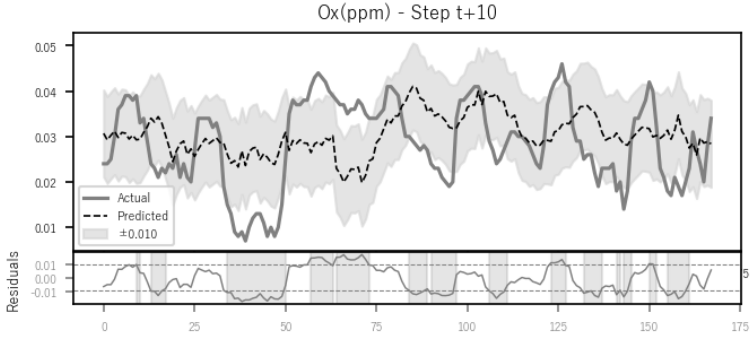

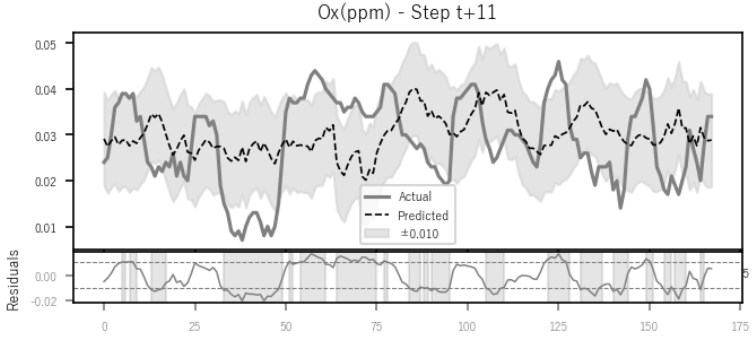

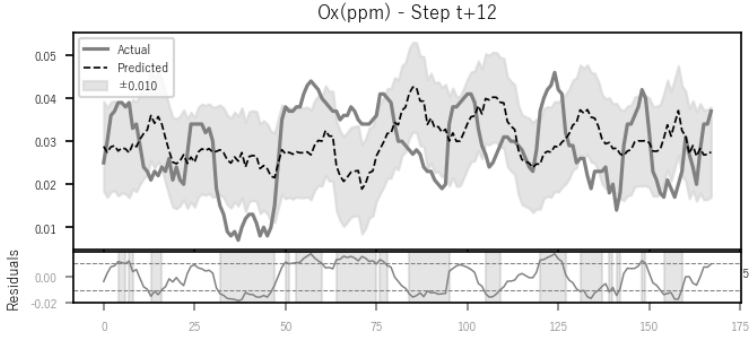

Comparison between actual and predicted values
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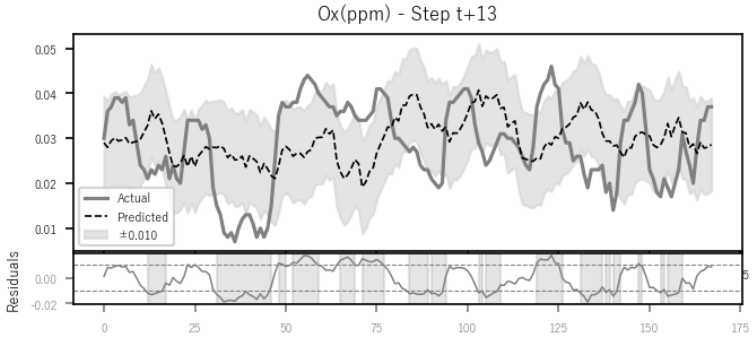

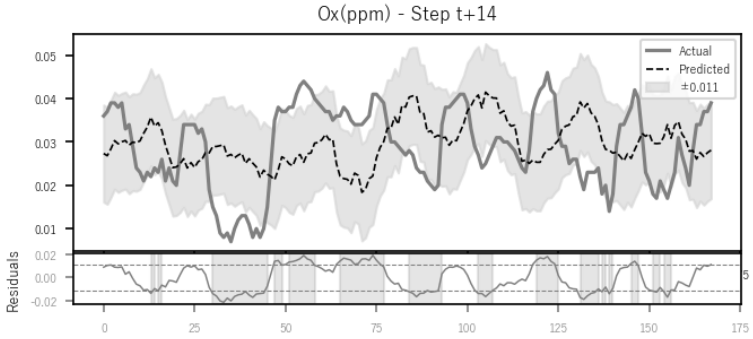

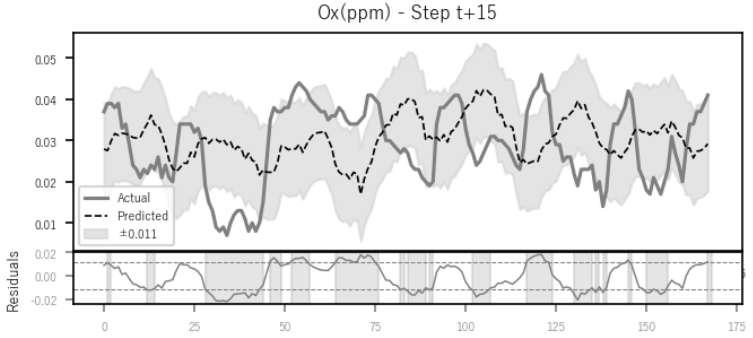

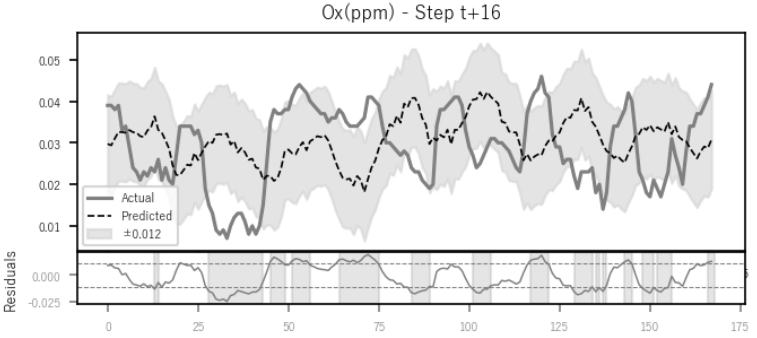

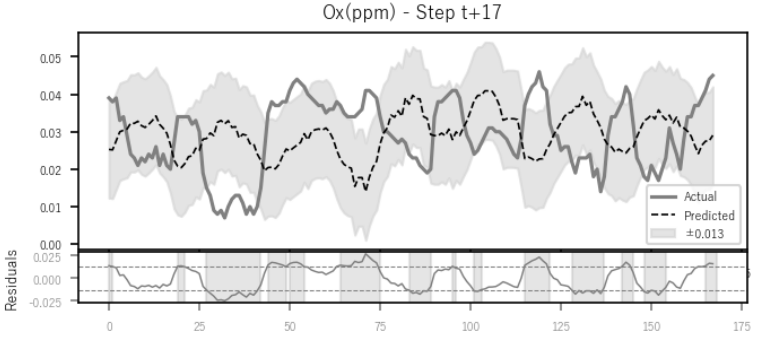

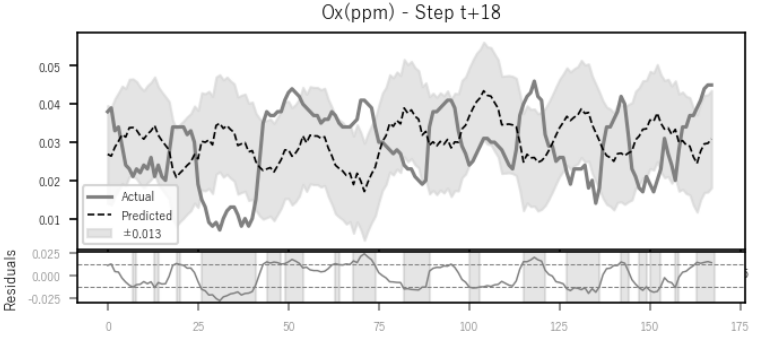

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