RNN 24-hour Forecast Report - 西条

$$h_t = \sigma(W_h x_t + U_h h_{t-1} + b_h)$$
$$\hat{y}_t = W_y h_t + b_y$$

$$\mathcal{L} = \frac{1}{N} \sum_{t=1}^{N} (y_t - \hat{y}_t)^2$$

x_t: input vector at time t
h_t: hidden state containing temporal information
W_h, U_h, b_h: learnable parameters of the recurrent layer
σ: non-linear activation function (usually tanh or ReLU)
$\hat{y}_t$: predicted output for step t
$\mathcal{L}$: mean squared error minimized during training

The Recurrent Neural Network (RNN) is designed to handle sequential data,
where each output depends not only on the current input but also on the previous hidden state.

At each time step, the hidden layer combines the current input x_t and the previous hidden state h_(t-1),
allowing the model to retain temporal information across steps.

The RNN is simpler than LSTM because it lacks explicit memory cells and gates.
This makes it more sensitive to vanishing gradient problems but still effective for short-term dependencies.

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

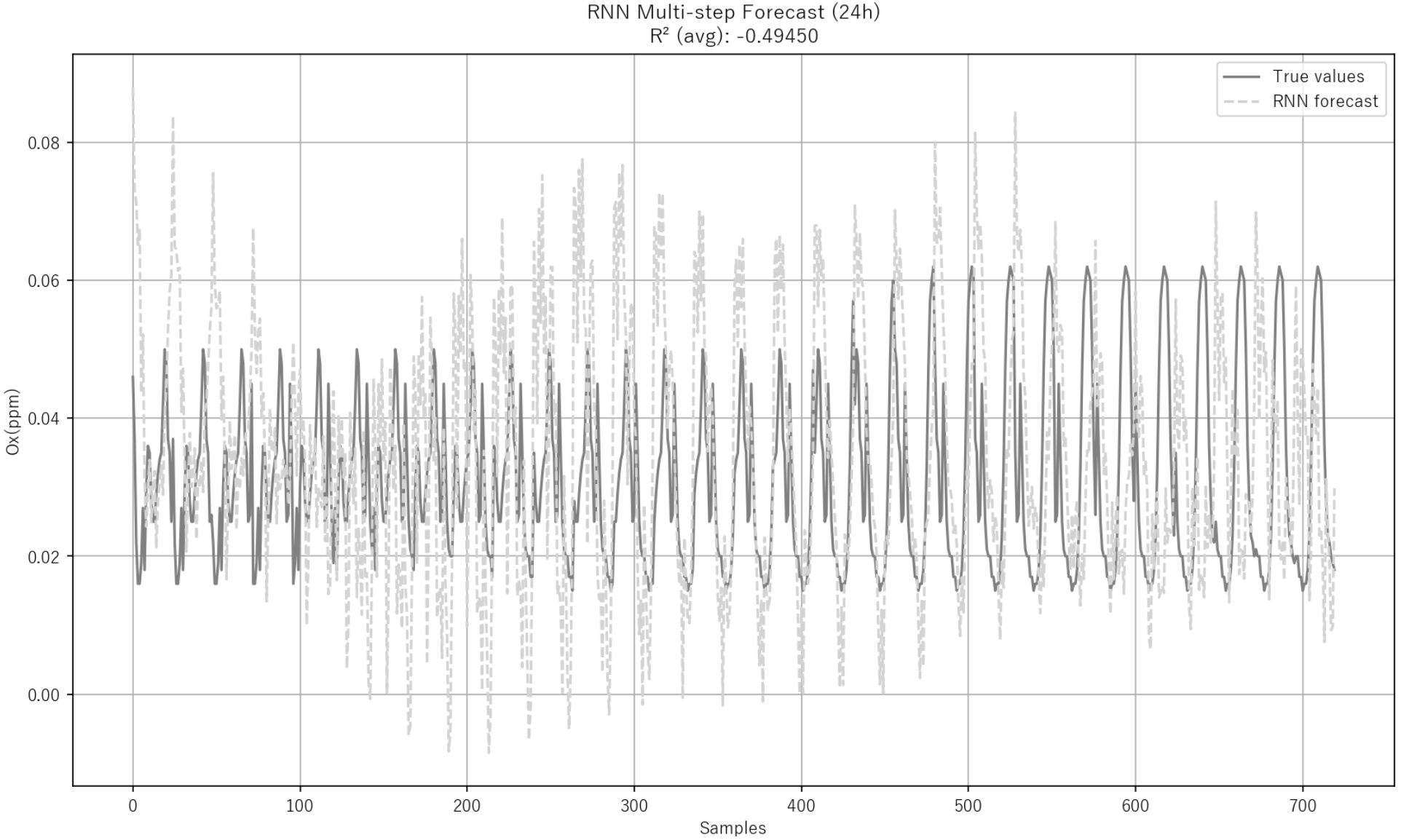
Prefecture code	38
Station code	38206050
Station name	西条
Target item	Ox(ppm)
Number of data points in the train set	15747
Number of data points in the test set	6749
Forecast horizon (hours)	24
Model	RNN
Elapsed time	0 min 3 sec
Number of features used	25
Residuals mean	-0.003365
Residuals median	-0.00324
Residuals mode	-0.001746

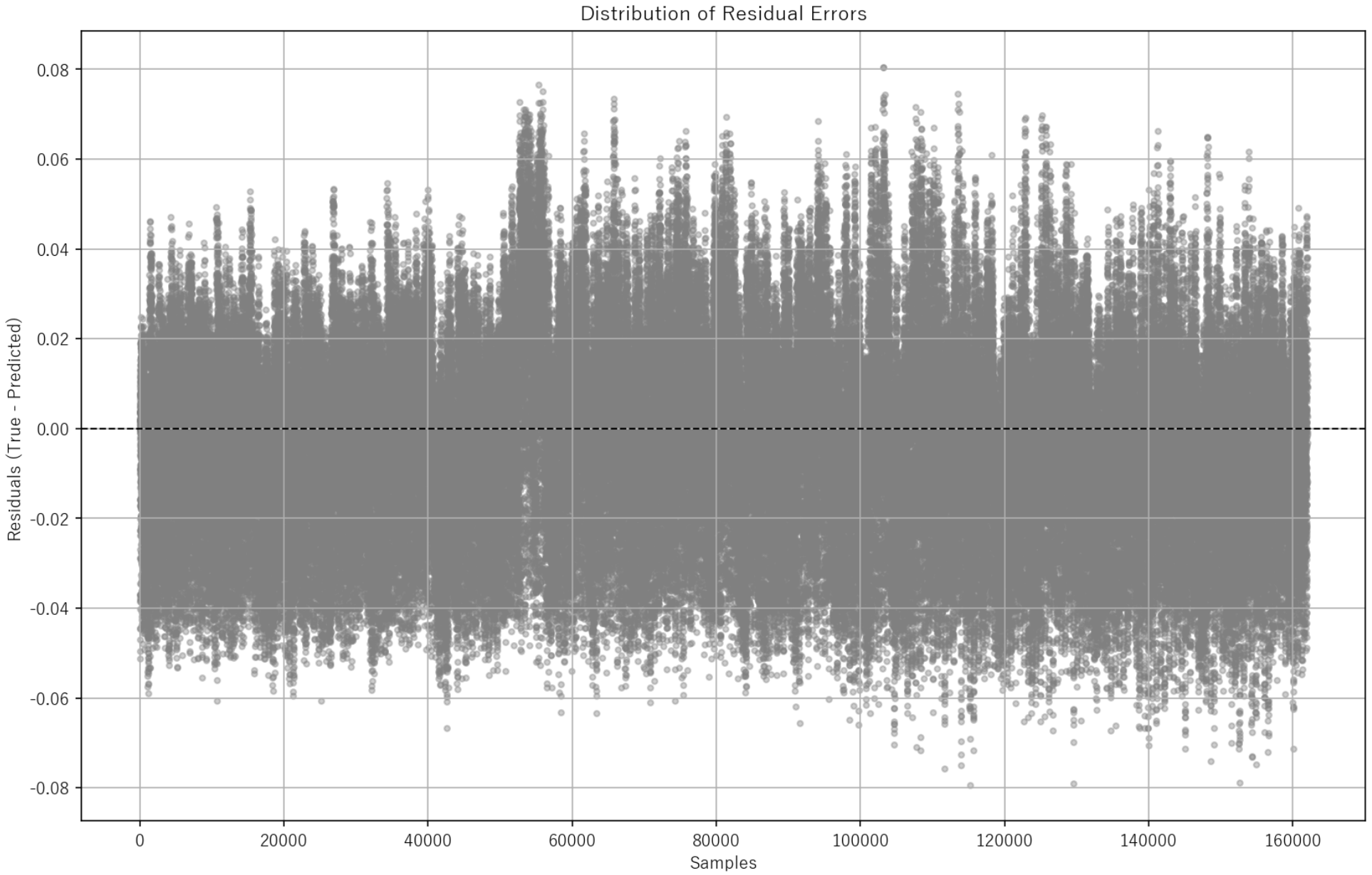
Features used for prediction

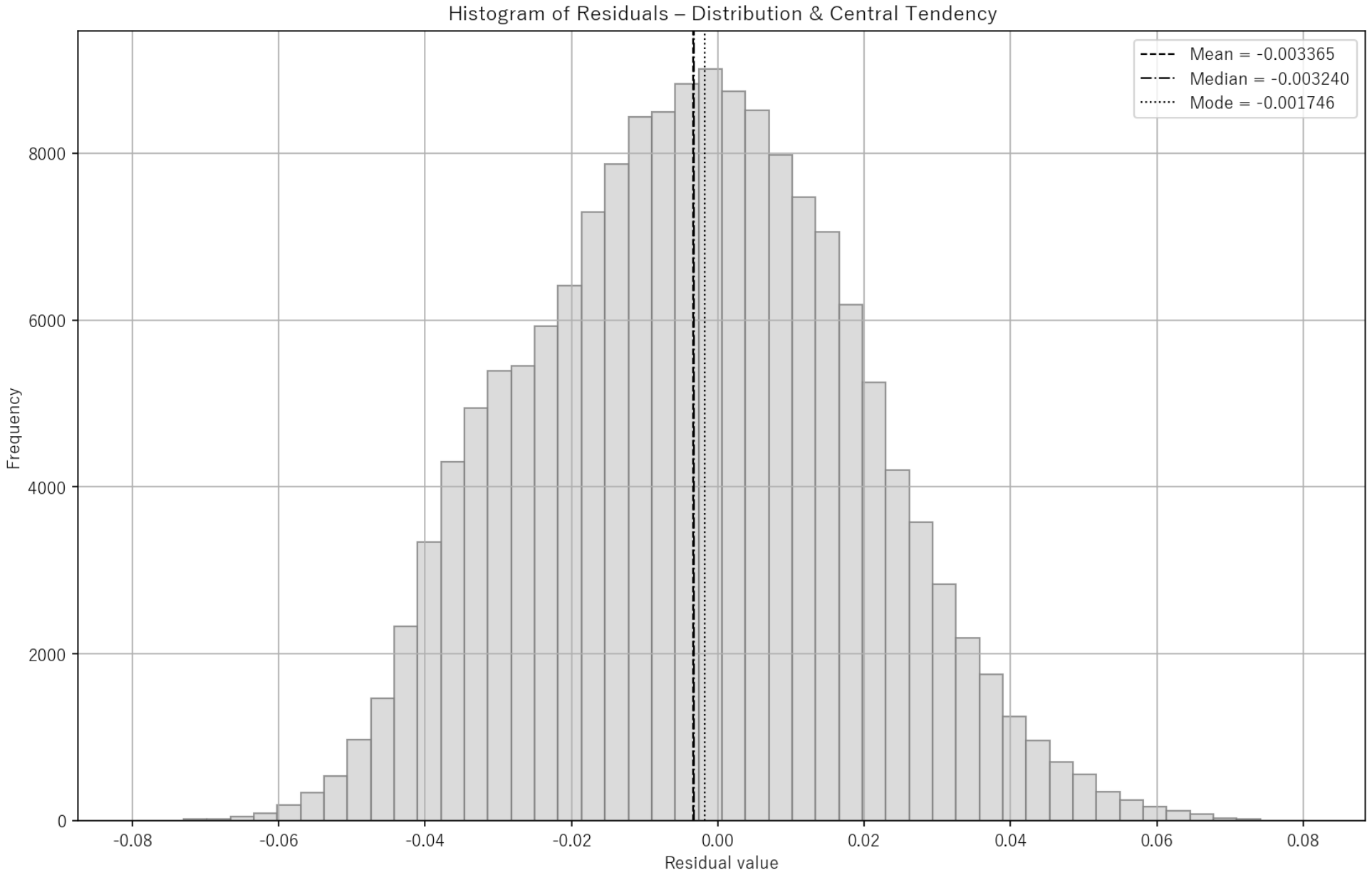
NO(ppm)	NO2(ppm)	U	V	Ox(ppm)_roll_mean_3
Ox(ppm)_roll_std_6	NO(ppm)_roll_mean_3	NO(ppm)_roll_std_6	NO2(ppm)_roll_mean_3	NO2(ppm)_roll_std_6
U_roll_mean_3	U_roll_std_6	V_roll_mean_3	V_roll_std_6	Ox(ppm)_diff_1
Ox(ppm)_diff_2	Ox(ppm)_diff_3	NO(ppm)_diff_3	NO2(ppm)_diff_3	U_diff_3
V_diff_3	hour_sin	hour_cos	dayofweek	is_weekend

Model accuracy

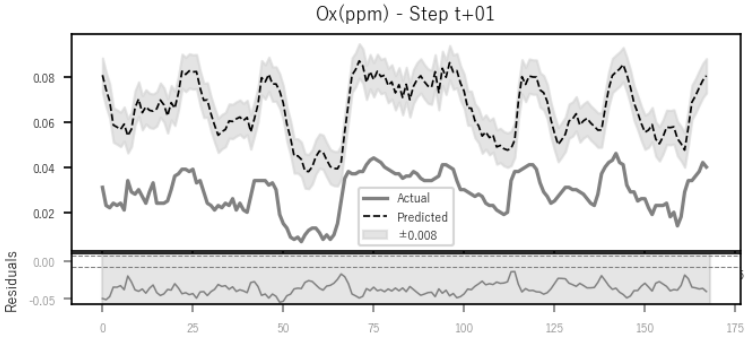
Target	R^2	MAE	RMSE
Ox(ppm)_t+01	-3.0883	0.0356	0.0369
Ox(ppm)_t+02	-1.7139	0.0280	0.0300
Ox(ppm)_t+03	-0.8162	0.0207	0.0246
Ox(ppm)_t+04	-2.0156	0.0295	0.0317
Ox(ppm)_t+05	-1.8350	0.0276	0.0307
Ox(ppm)_t+06	-1.0723	0.0231	0.0263
Ox(ppm)_t+07	-0.6667	0.0203	0.0236
Ox(ppm)_t+08	0.2376	0.0132	0.0159
Ox(ppm)_t+09	-0.1592	0.0153	0.0196
Ox(ppm)_t+10	0.1522	0.0138	0.0168
Ox(ppm)_t+11	0.2040	0.0138	0.0163
Ox(ppm)_t+12	0.2805	0.0127	0.0155
Ox(ppm)_t+13	0.3140	0.0120	0.0151
Ox(ppm)_t+14	0.3472	0.0115	0.0147
Ox(ppm)_t+15	-0.4246	0.0168	0.0218
Ox(ppm)_t+16	-0.3078	0.0169	0.0209
Ox(ppm)_t+17	-0.2766	0.0161	0.0206
Ox(ppm)_t+18	-0.8230	0.0204	0.0247
Ox(ppm)_t+19	-0.3263	0.0163	0.0210
Ox(ppm)_t+20	0.0955	0.0133	0.0174
Ox(ppm)_t+21	-0.1580	0.0153	0.0196
Ox(ppm)_t+22	-0.2591	0.0167	0.0205
Ox(ppm)_t+23	0.1254	0.0136	0.0171
Ox(ppm)_t+24	0.3184	0.0118	0.0151

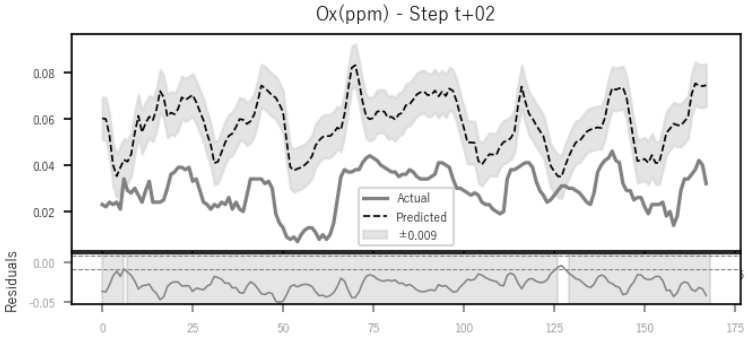

RNN Multi-step Forecast (24h)
R² (avg): -0.49450
True values
RNN forecast
Ox(ppm)
0.08
0.06
0.04
0.02
0.00
0
100
200
300
400
500
600
700
Samples

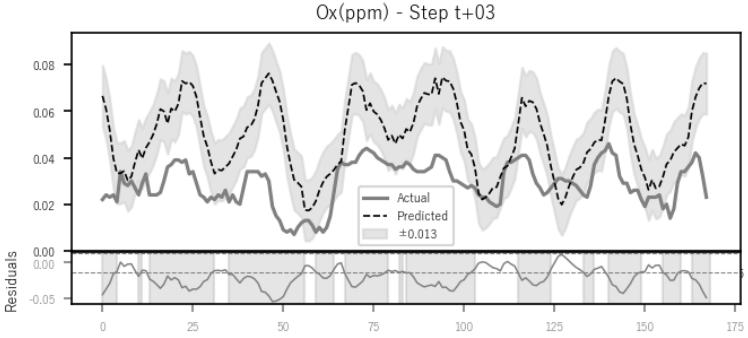

Distribution of Residual Errors
Residuals (True - Predicted)
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
0
20000
40000
60000
80000
100000
120000
140000
160000
Samples

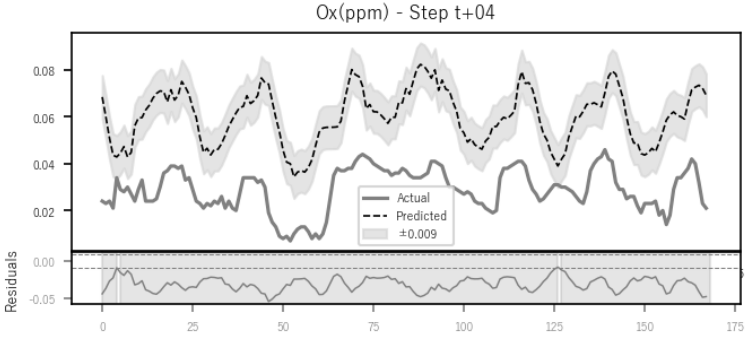

Histogram of Residuals – Distribution & Central Tendency
Mean = -0.003365
Median = -0.003240
Mode = -0.001746
Frequency
0
2000
4000
6000
8000
-0.08
-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06
0.08
Residual value

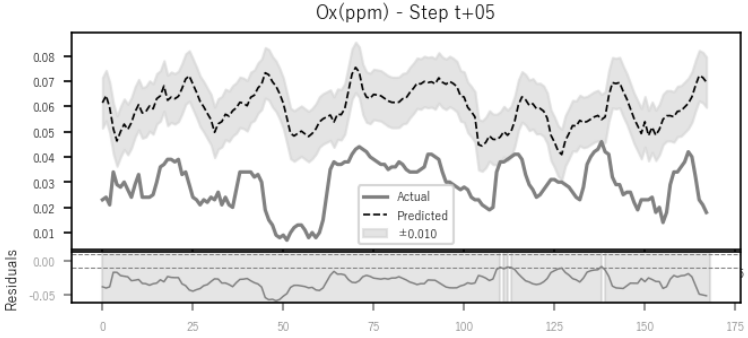
Comparison between actual and predicted values
with ± Standard Deviation Bands

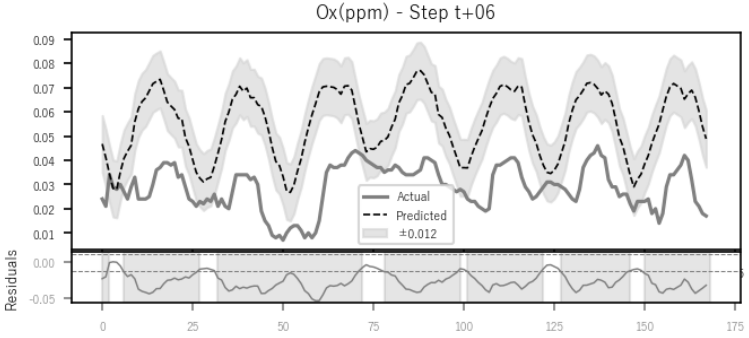












Comparison between actual and predicted values
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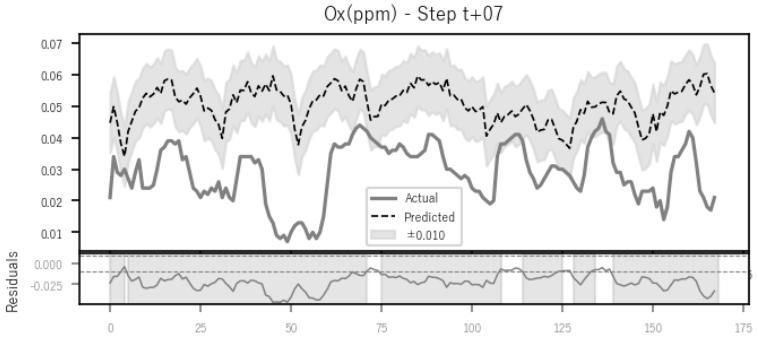

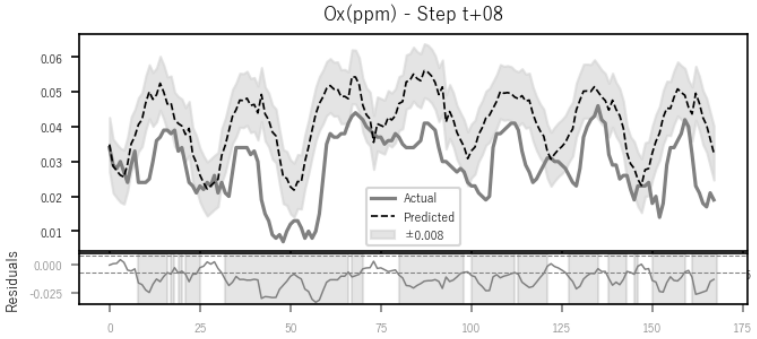

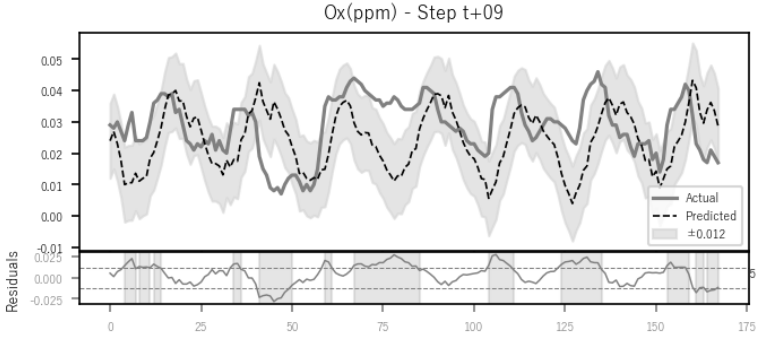

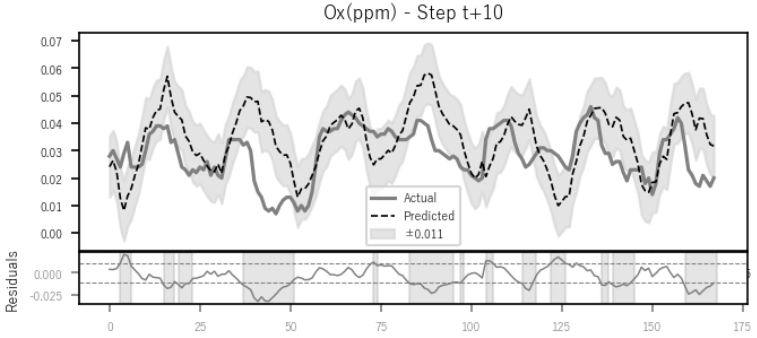

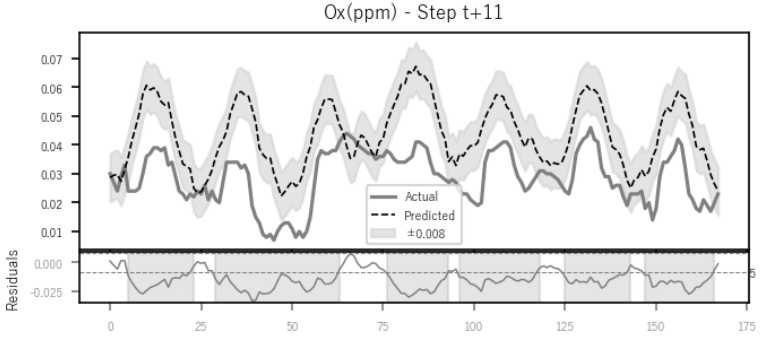

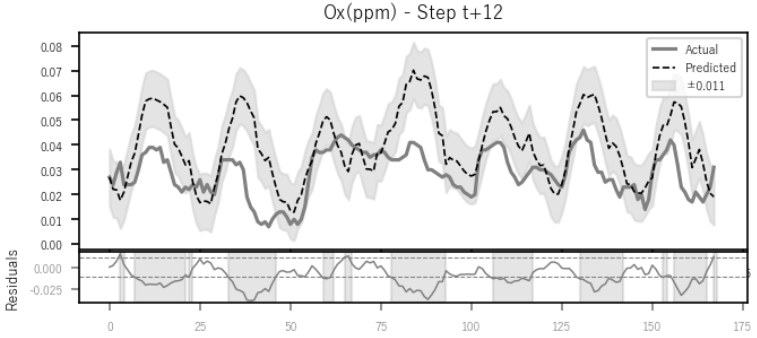

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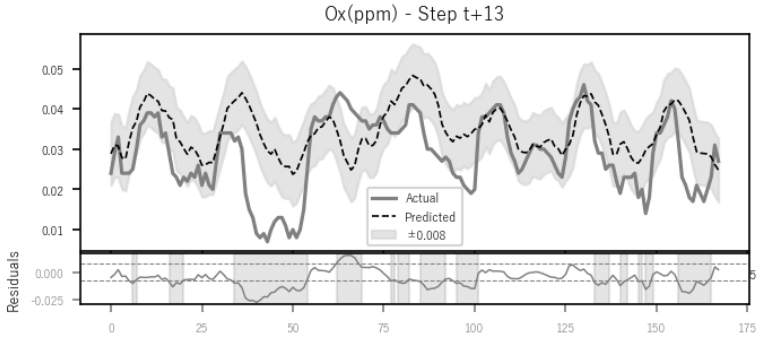

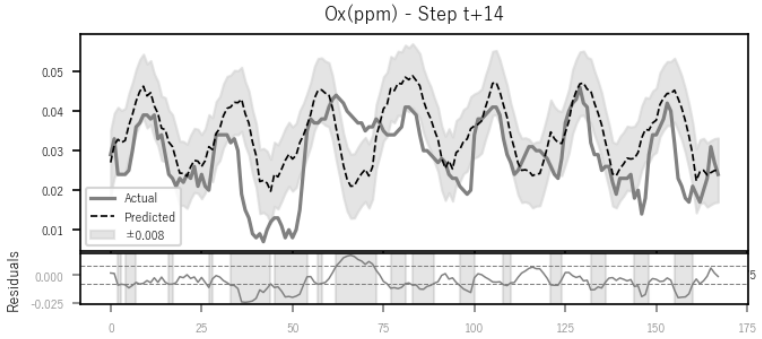

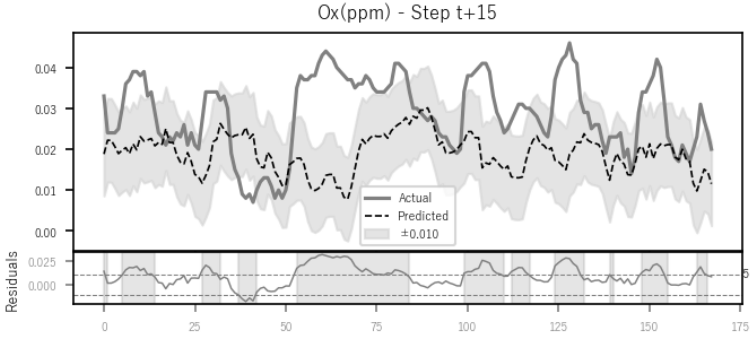

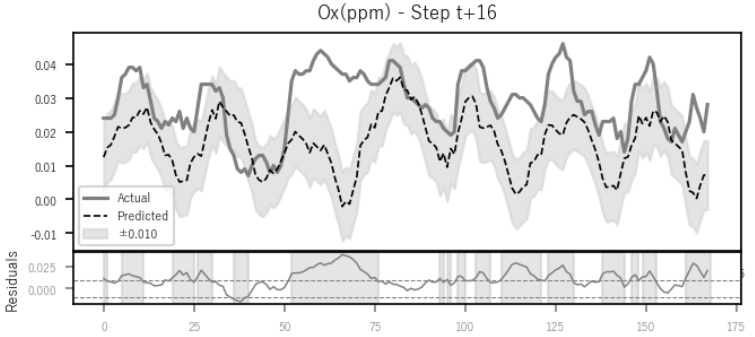

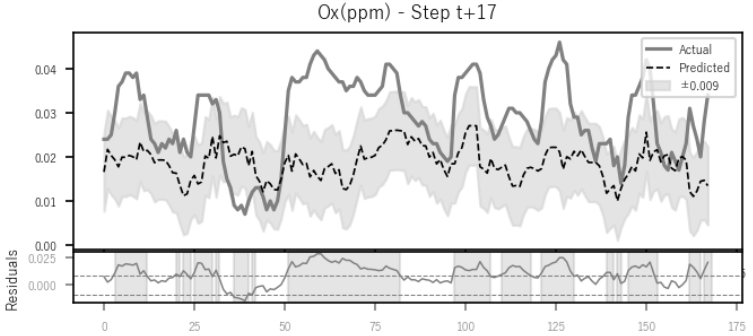

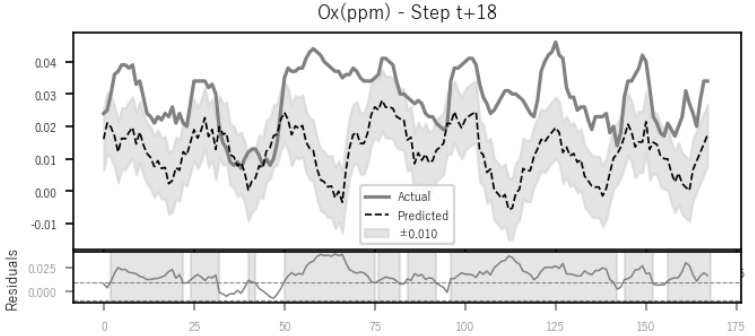

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