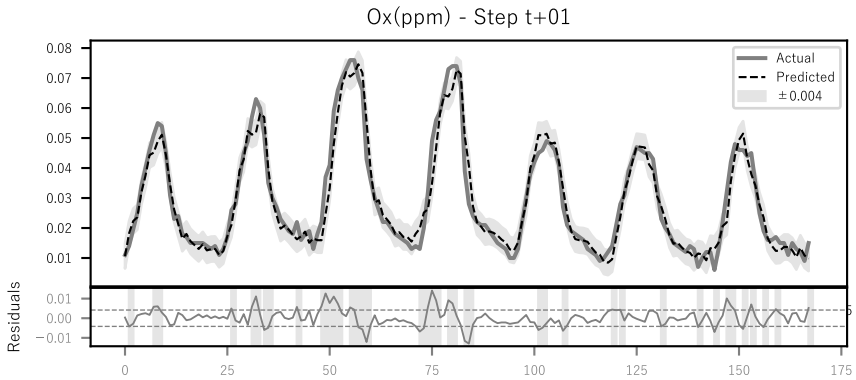
西条 - オキシダント予測の分析 (CatBoost)

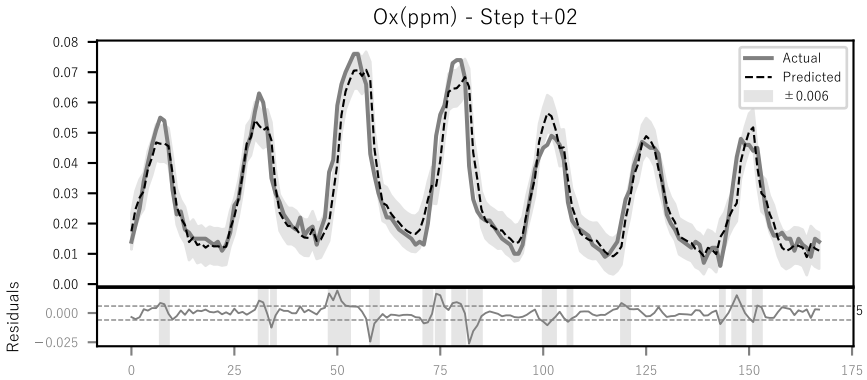
Model Parameters:
Prefecture code: 38
Station code: 38206050
Station name: 西条
Target item: Ox(ppm)
Forecast horizon: 24
Train size: 13685
Test size: 5866
Model: CatBoost
Iterations: 500
Learning rate: 0.05
Depth: 6
Loss function: RMSE
Elapsed time: 2 min 1 sec
Number of used features: 140

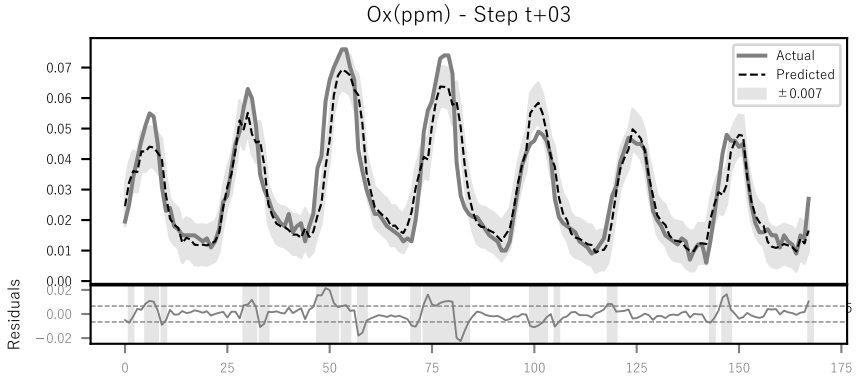
Features:
NO(ppm), NO2(ppm), U, V, Ox(ppm)_lag1
Ox(ppm)_lag2, Ox(ppm)_lag3, Ox(ppm)_lag4, Ox(ppm)_lag5, Ox(ppm)_lag6
Ox(ppm)_lag7, Ox(ppm)_lag8, Ox(ppm)_lag9, Ox(ppm)_lag10, Ox(ppm)_lag11
Ox(ppm)_lag12, Ox(ppm)_lag13, Ox(ppm)_lag14, Ox(ppm)_lag15, Ox(ppm)_lag16
Ox(ppm)_lag17, Ox(ppm)_lag18, Ox(ppm)_lag19, Ox(ppm)_lag20, Ox(ppm)_lag21
Ox(ppm)_lag22, Ox(ppm)_lag23, NO(ppm)_lag1, NO(ppm)_lag2, NO(ppm)_lag3
NO(ppm)_lag4, NO(ppm)_lag5, NO(ppm)_lag6, NO(ppm)_lag7, NO(ppm)_lag8
NO(ppm)_lag9, NO(ppm)_lag10, NO(ppm)_lag11, NO(ppm)_lag12, NO(ppm)_lag13
NO(ppm)_lag14, NO(ppm)_lag15, NO(ppm)_lag16, NO(ppm)_lag17, NO(ppm)_lag18
NO(ppm)_lag19, NO(ppm)_lag20, NO(ppm)_lag21, NO(ppm)_lag22, NO(ppm)_lag23
NO2(ppm)_lag1, NO2(ppm)_lag2, NO2(ppm)_lag3, NO2(ppm)_lag4, NO2(ppm)_lag5
NO2(ppm)_lag6, NO2(ppm)_lag7, NO2(ppm)_lag8, NO2(ppm)_lag9, NO2(ppm)_lag10
NO2(ppm)_lag11, NO2(ppm)_lag12, NO2(ppm)_lag13, NO2(ppm)_lag14, NO2(ppm)_lag15
NO2(ppm)_lag16, NO2(ppm)_lag17, NO2(ppm)_lag18, NO2(ppm)_lag19, NO2(ppm)_lag20
NO2(ppm)_lag21, NO2(ppm)_lag22, NO2(ppm)_lag23, U_lag1, U_lag2
U_lag3, U_lag4, U_lag5, U_lag6, U_lag7
U_lag8, U_lag9, U_lag10, U_lag11, U_lag12
U_lag13, U_lag14, U_lag15, U_lag16, U_lag17
U_lag18, U_lag19, U_lag20, U_lag21, U_lag22
U_lag23, V_lag1, V_lag2, V_lag3, V_lag4
V_lag5, V_lag6, V_lag7, V_lag8, V_lag9
V_lag10, V_lag11, V_lag12, V_lag13, V_lag14
V_lag15, V_lag16, V_lag17, V_lag18, V_lag19
V_lag20, V_lag21, V_lag22, V_lag23, 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

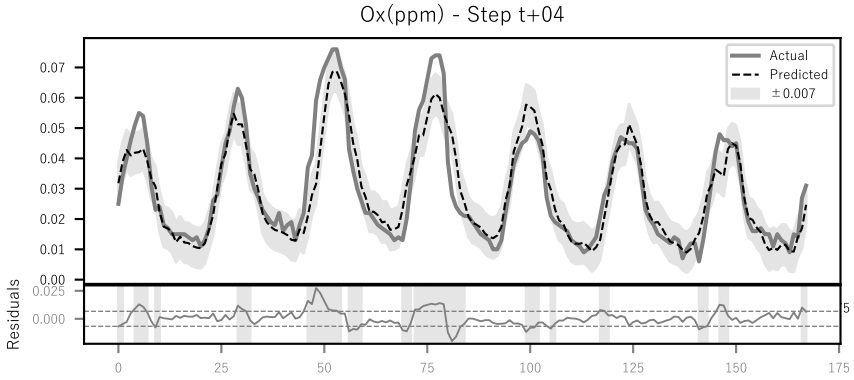
Metrics per Forecast Step:
Ox(ppm)_t+01 - R^2: 0.8990, MAE: 0.0037, RMSE: 0.0051
Ox(ppm)_t+02 - R^2: 0.8361, MAE: 0.0047, RMSE: 0.0065
Ox(ppm)_t+03 - R^2: 0.7851, MAE: 0.0054, RMSE: 0.0074
Ox(ppm)_t+04 - R^2: 0.7407, MAE: 0.0060, RMSE: 0.0081
Ox(ppm)_t+05 - R^2: 0.6994, MAE: 0.0065, RMSE: 0.0088
Ox(ppm)_t+06 - R^2: 0.6611, MAE: 0.0069, RMSE: 0.0093
Ox(ppm)_t+07 - R^2: 0.6261, MAE: 0.0072, RMSE: 0.0098
Ox(ppm)_t+08 - R^2: 0.6067, MAE: 0.0074, RMSE: 0.0100
Ox(ppm)_t+09 - R^2: 0.5759, MAE: 0.0077, RMSE: 0.0104
Ox(ppm)_t+10 - R^2: 0.5475, MAE: 0.0079, RMSE: 0.0107
Ox(ppm)_t+11 - R^2: 0.5372, MAE: 0.0080, RMSE: 0.0109
Ox(ppm)_t+12 - R^2: 0.5142, MAE: 0.0082, RMSE: 0.0111
Ox(ppm)_t+13 - R^2: 0.5040, MAE: 0.0083, RMSE: 0.0113
Ox(ppm)_t+14 - R^2: 0.4974, MAE: 0.0084, RMSE: 0.0113
Ox(ppm)_t+15 - R^2: 0.4817, MAE: 0.0085, RMSE: 0.0115
Ox(ppm)_t+16 - R^2: 0.4733, MAE: 0.0086, RMSE: 0.0116
Ox(ppm)_t+17 - R^2: 0.4699, MAE: 0.0087, RMSE: 0.0116
Ox(ppm)_t+18 - R^2: 0.4544, MAE: 0.0087, RMSE: 0.0118
Ox(ppm)_t+19 - R^2: 0.4468, MAE: 0.0088, RMSE: 0.0119
Ox(ppm)_t+20 - R^2: 0.4533, MAE: 0.0088, RMSE: 0.0118
Ox(ppm)_t+21 - R^2: 0.4567, MAE: 0.0088, RMSE: 0.0118
Ox(ppm)_t+22 - R^2: 0.4462, MAE: 0.0088, RMSE: 0.0119
Ox(ppm)_t+23 - R^2: 0.4530, MAE: 0.0088, RMSE: 0.0118
Ox(ppm)_t+24 - R^2: 0.4519, MAE: 0.0089, RMSE: 0.0118

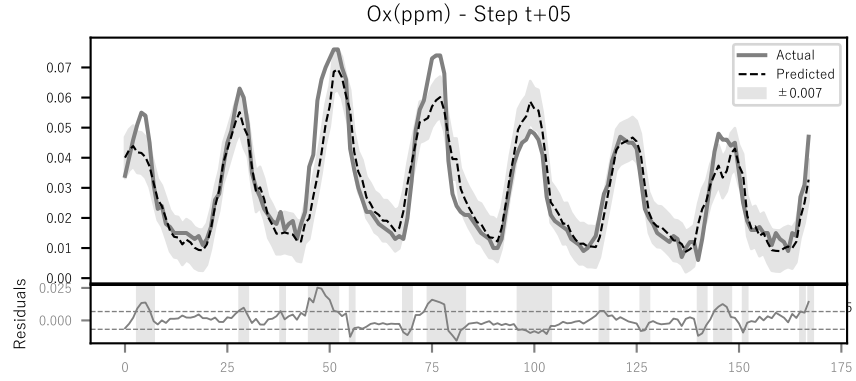
Comparison between actual and predicted values
with ± Standard Deviation Bands

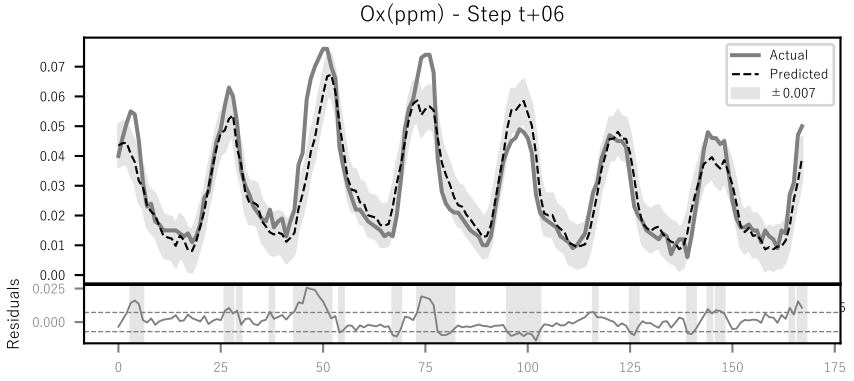




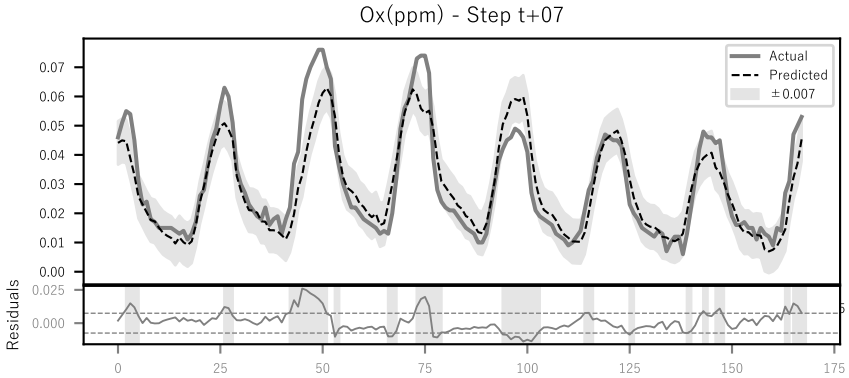


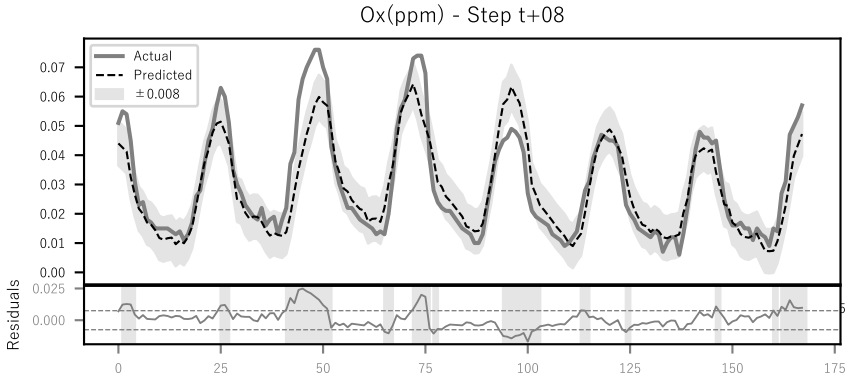


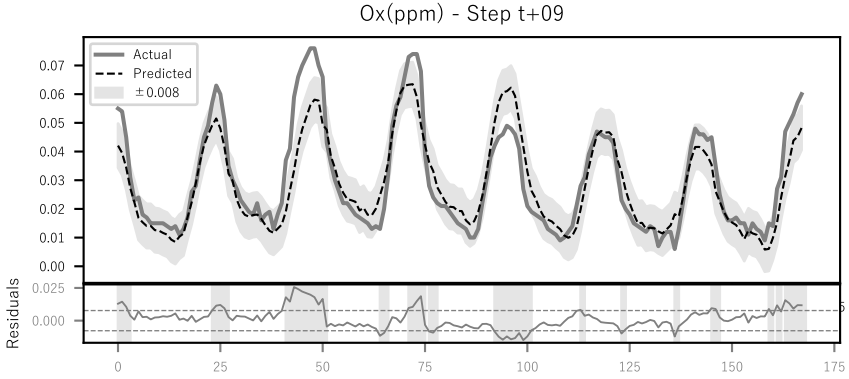


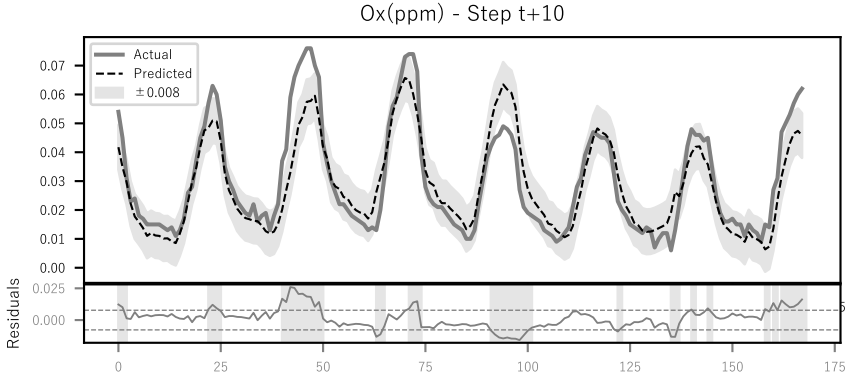


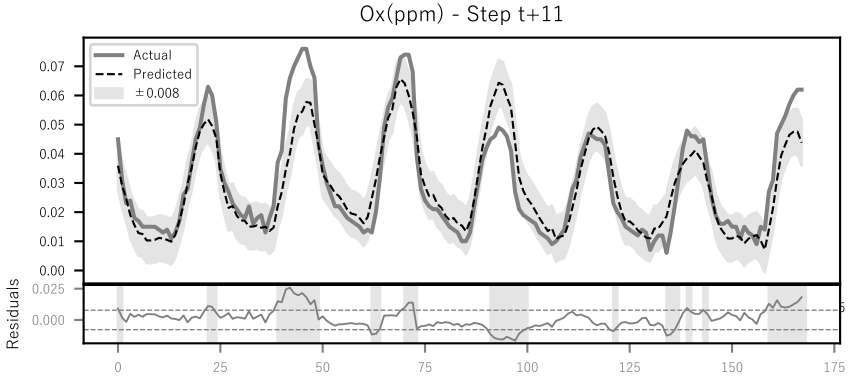
Comparison between actual and predicted values
with ± Standard Deviation Bands

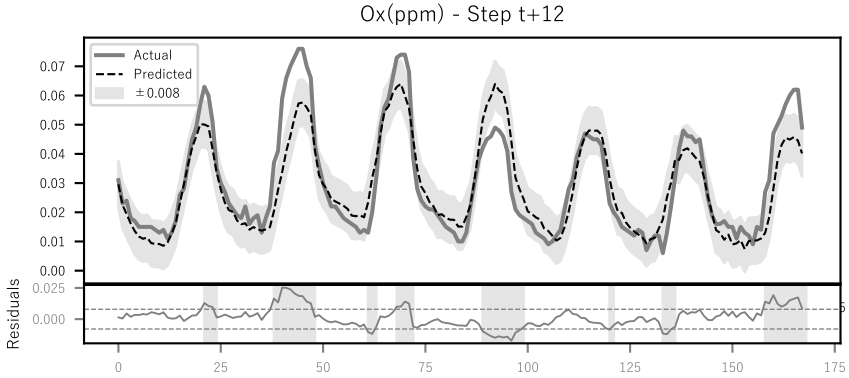




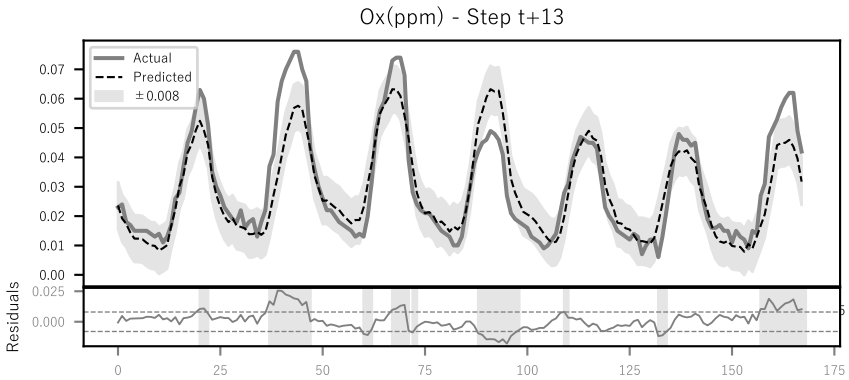


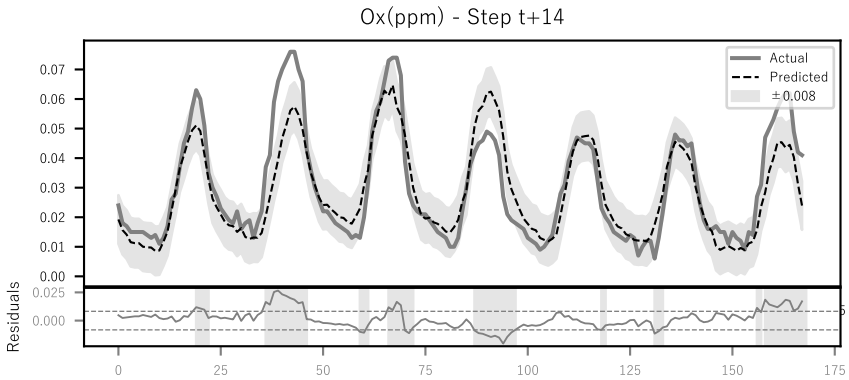


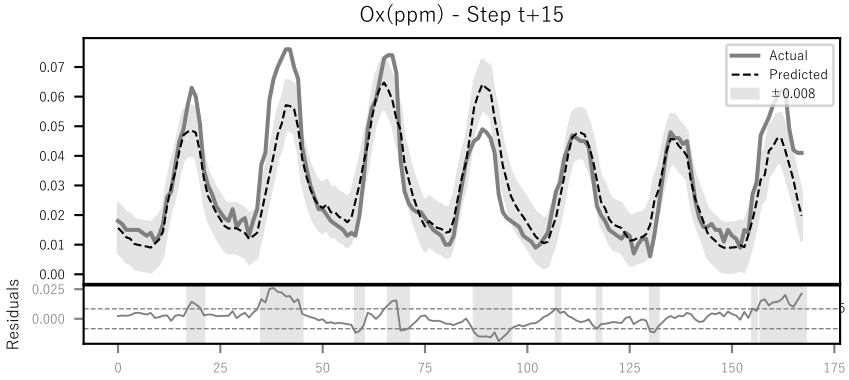


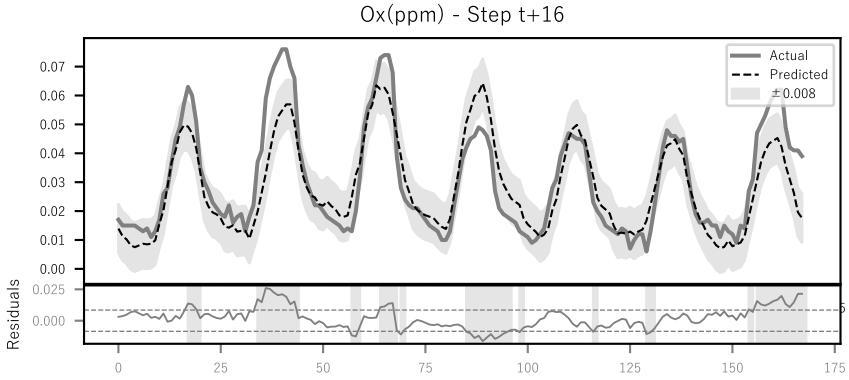


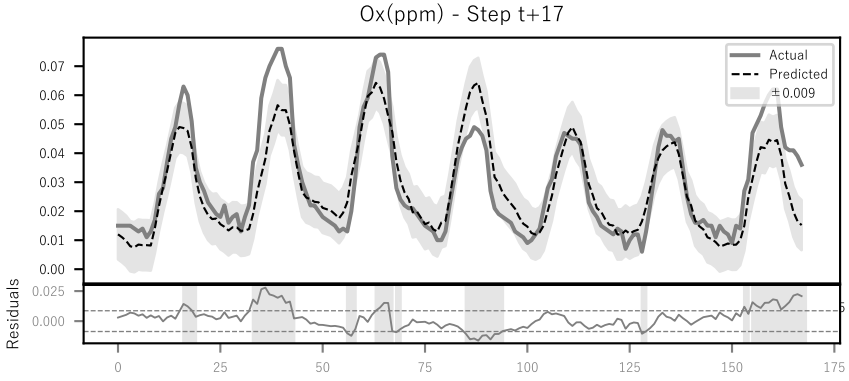
Comparison between actual and predicted values
with ± Standard Deviation Bands

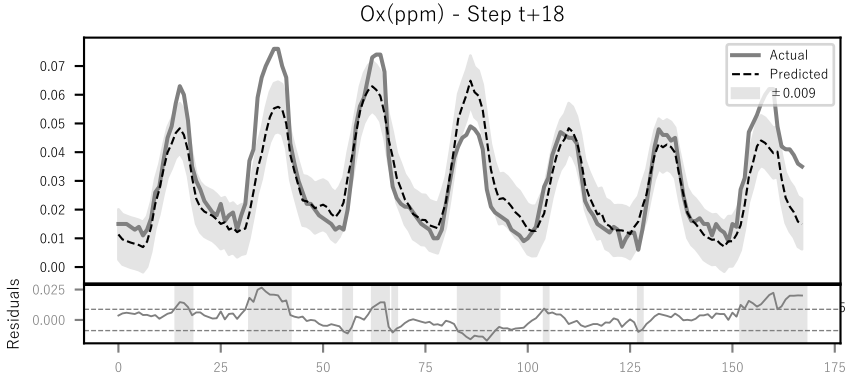




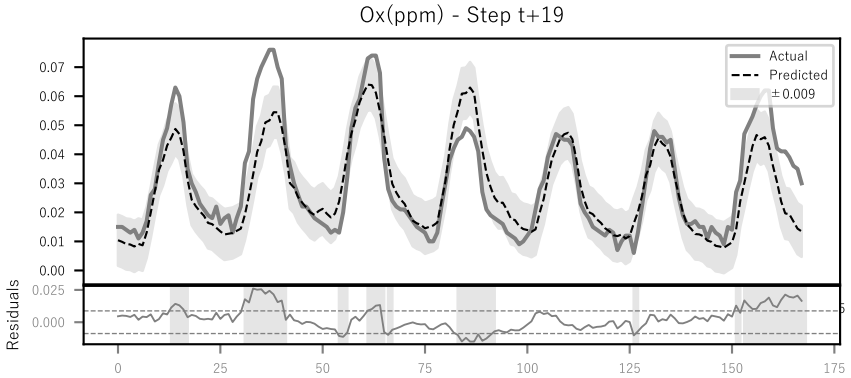


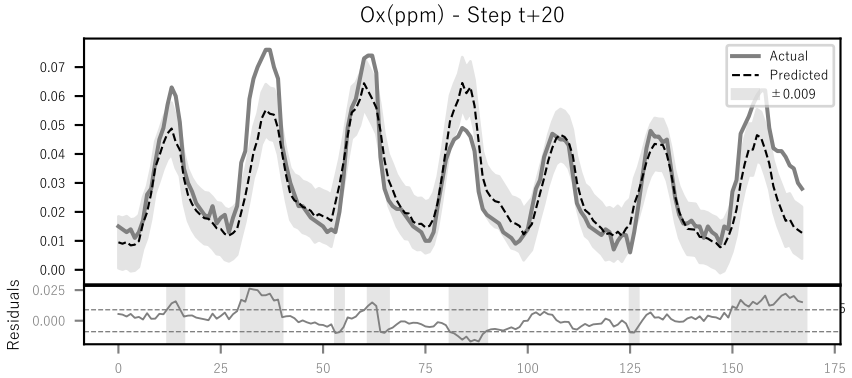


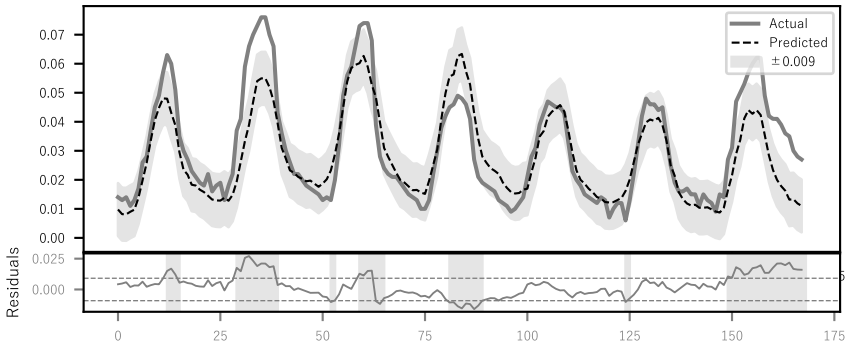


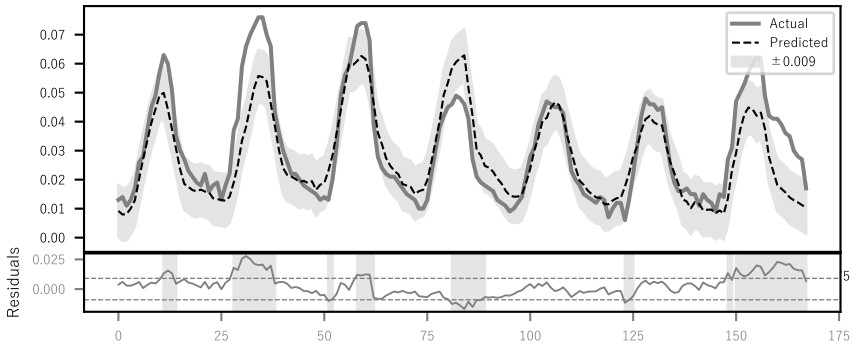


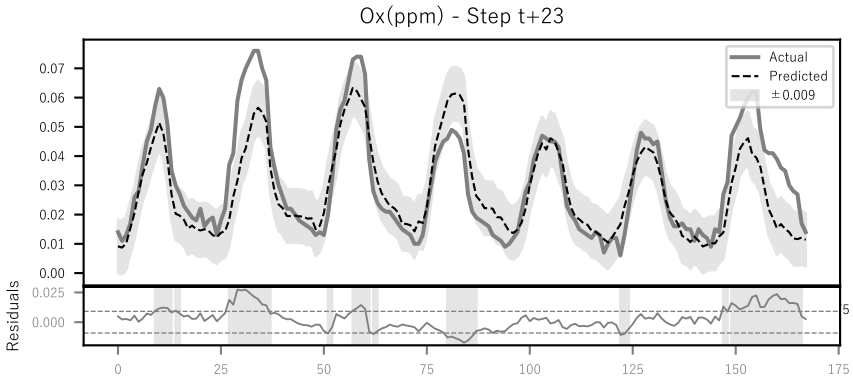
Comparison between actual and predicted values
with ± Standard Deviation Bands

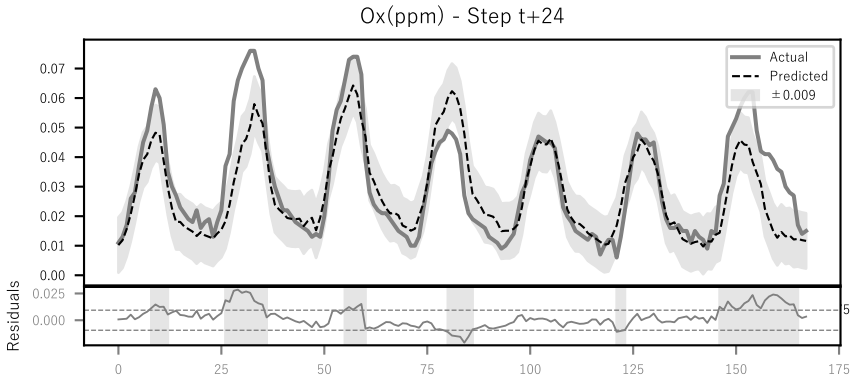


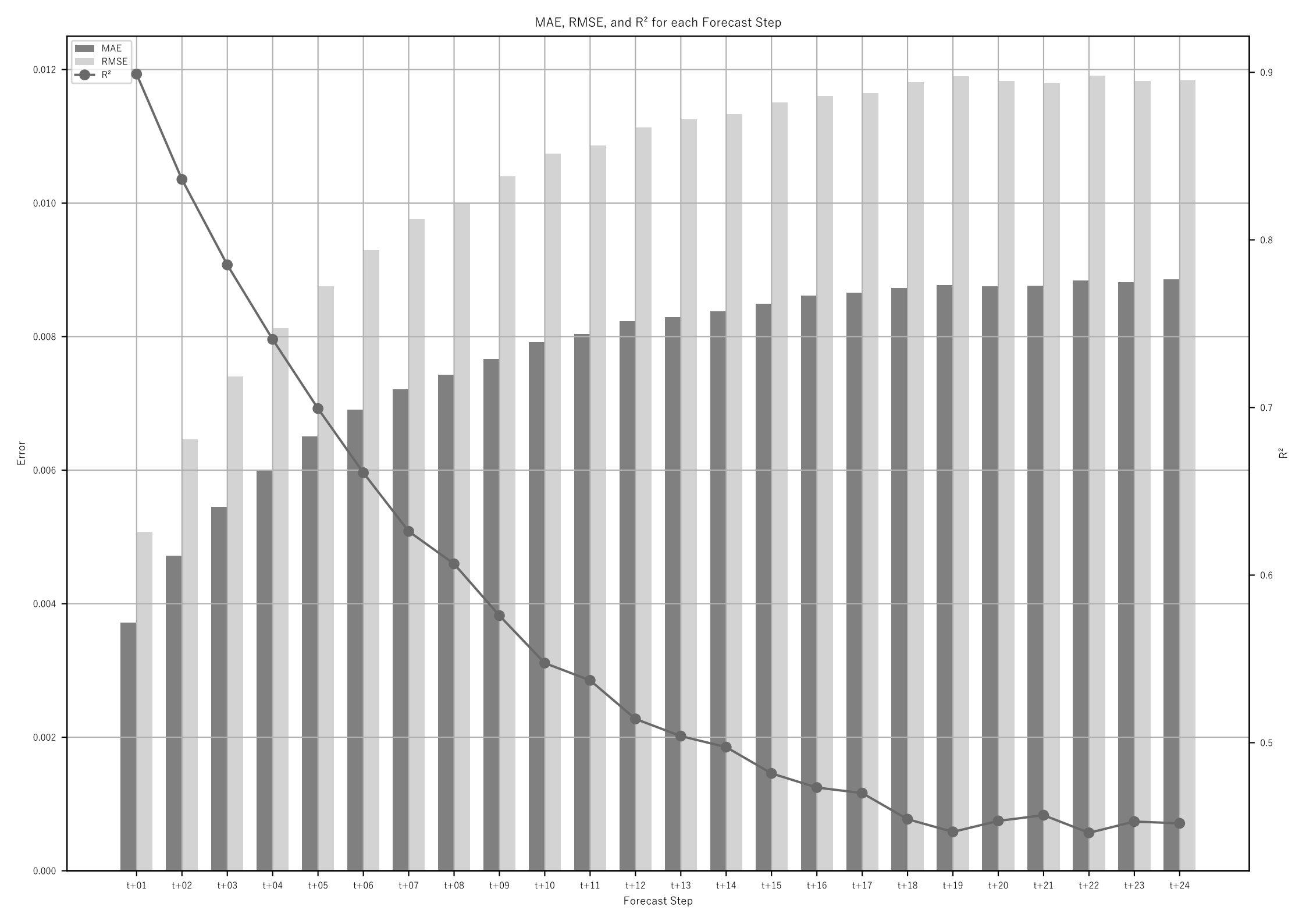











MAE, RMSE, and R² for each Forecast Step
MAE
RMSE
R²
Error
R²
Forecast Step
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.5
0.6
0.7
0.8
0.9
t+01
t+02
t+03
t+04
t+05
t+06
t+07
t+08
t+09
t+10
t+11
t+12
t+13
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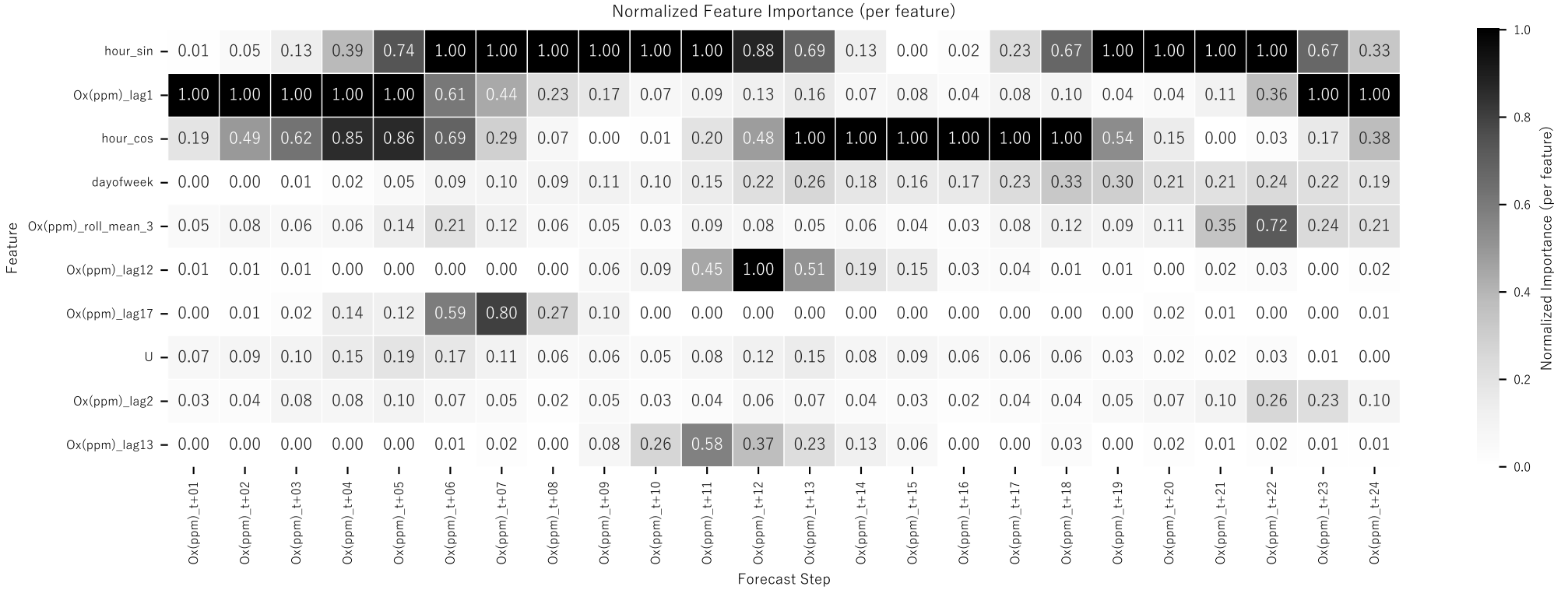
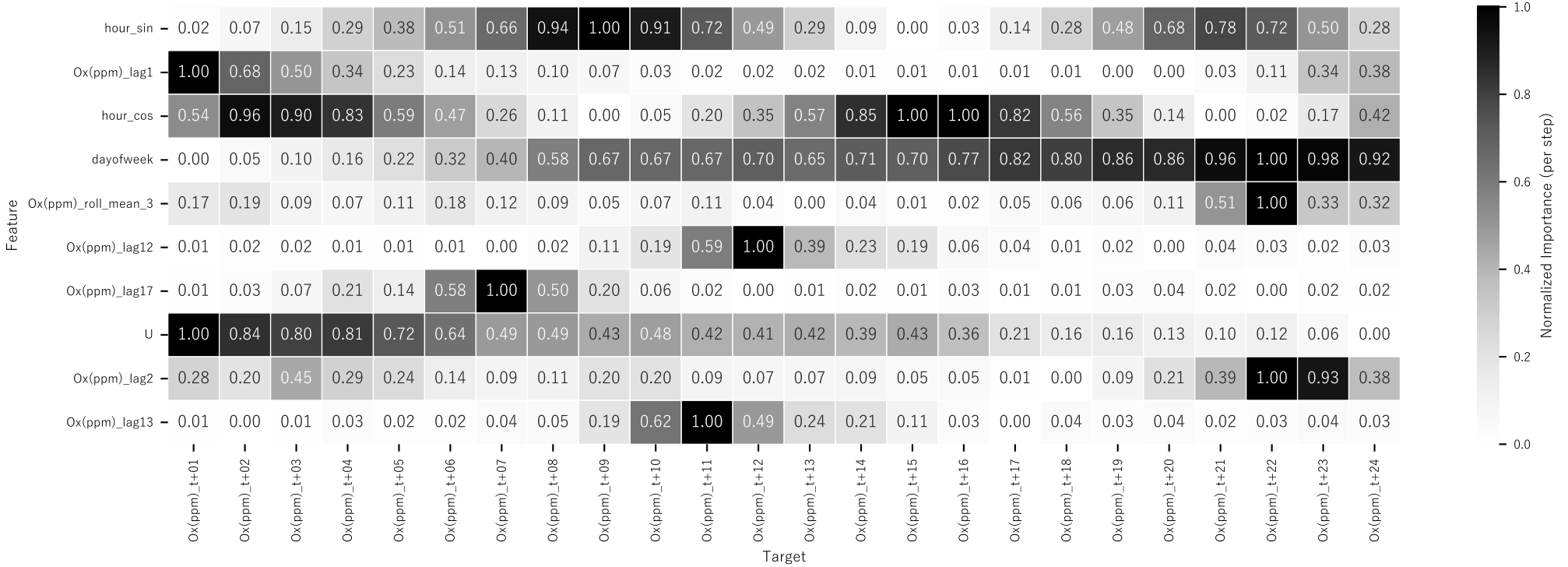
t+19
t+20
t+21
t+22
t+23
t+24


Normalized Feature Importance (per feature)
Feature
hour_sin 0.01 0.05 0.13 0.39 0.74 1.00 1.00 1.00 1.00 1.00 1.00 0.88 0.69 0.13 0.00 0.02 0.23 0.67 1.00 1.00 1.00 1.00 0.67 0.33
Ox(ppm)_lag1 1.00 1.00 1.00 1.00 1.00 0.61 0.44 0.23 0.17 0.07 0.09 0.13 0.16 0.07 0.08 0.04 0.08 0.10 0.04 0.04 0.11 0.36 1.00 1.00
hour_cos 0.19 0.49 0.62 0.85 0.86 0.69 0.29 0.07 0.00 0.01 0.20 0.48 1.00 1.00 1.00 1.00 1.00 1.00 0.54 0.15 0.00 0.03 0.17 0.38
dayofweek 0.00 0.00 0.01 0.02 0.05 0.09 0.10 0.09 0.11 0.10 0.15 0.22 0.26 0.18 0.16 0.17 0.23 0.33 0.30 0.21 0.21 0.24 0.22 0.19
Ox(ppm)_roll_mean_3 0.05 0.08 0.06 0.06 0.14 0.21 0.12 0.06 0.05 0.03 0.09 0.08 0.05 0.06 0.04 0.03 0.08 0.12 0.09 0.11 0.35 0.72 0.24 0.21
Ox(ppm)_lag12 0.01 0.01 0.01 0.00 0.00 0.00 0.00 0.00 0.06 0.09 0.45 1.00 0.51 0.19 0.15 0.03 0.04 0.01 0.01 0.00 0.02 0.03 0.00 0.02
Ox(ppm)_lag17 0.00 0.01 0.02 0.14 0.12 0.59 0.80 0.27 0.10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.01 0.00 0.00 0.01
U 0.07 0.09 0.10 0.15 0.19 0.17 0.11 0.06 0.06 0.05 0.08 0.12 0.15 0.08 0.09 0.06 0.06 0.06 0.03 0.02 0.02 0.03 0.01 0.00
Ox(ppm)_lag2 0.03 0.04 0.08 0.08 0.10 0.07 0.05 0.02 0.05 0.03 0.04 0.06 0.07 0.04 0.03 0.02 0.04 0.04 0.05 0.07 0.10 0.26 0.23 0.10
Ox(ppm)_lag13 0.00 0.00 0.00 0.00 0.00 0.01 0.02 0.00 0.08 0.26 0.58 0.37 0.23 0.13 0.06 0.00 0.00 0.03 0.00 0.02 0.01 0.02 0.01 0.01
Ox(ppm)_t+01 Ox(ppm)_t+02 Ox(ppm)_t+03 Ox(ppm)_t+04 Ox(ppm)_t+05 Ox(ppm)_t+06 Ox(ppm)_t+07 Ox(ppm)_t+08 Ox(ppm)_t+09 Ox(ppm)_t+10 Ox(ppm)_t+11 Ox(ppm)_t+12 Ox(ppm)_t+13 Ox(ppm)_t+14 Ox(ppm)_t+15 Ox(ppm)_t+16 Ox(ppm)_t+17 Ox(ppm)_t+18 Ox(ppm)_t+19 Ox(ppm)_t+20 Ox(ppm)_t+21 Ox(ppm)_t+22 Ox(ppm)_t+23 Ox(ppm)_t+24
Forecast Step
Normalized Importance (per feature)
1.0
0.8
0.6
0.4
0.2
0.0


Normalized Feature Importance (per step)
Feature
hour_sin 0.02 0.07 0.15 0.29 0.38 0.51 0.66 0.94 1.00 0.91 0.72 0.49 0.29 0.09 0.00 0.03 0.14 0.28 0.48 0.68 0.78 0.72 0.50 0.28
Ox(ppm)_lag1 1.00 0.68 0.50 0.34 0.23 0.14 0.13 0.10 0.07 0.03 0.02 0.02 0.02 0.01 0.01 0.01 0.01 0.01 0.00 0.00 0.03 0.11 0.34 0.38
hour_cos 0.54 0.96 0.90 0.83 0.59 0.47 0.26 0.11 0.00 0.05 0.20 0.35 0.57 0.85 1.00 1.00 0.82 0.56 0.35 0.14 0.00 0.02 0.17 0.42
dayofweek 0.00 0.05 0.10 0.16 0.22 0.32 0.40 0.58 0.67 0.67 0.67 0.70 0.65 0.71 0.70 0.77 0.82 0.80 0.86 0.86 0.96 1.00 0.98 0.92
Ox(ppm)_roll_mean_3 0.17 0.19 0.09 0.07 0.11 0.18 0.12 0.09 0.05 0.07 0.11 0.04 0.00 0.04 0.01 0.02 0.05 0.06 0.06 0.11 0.51 1.00 0.33 0.32
Ox(ppm)_lag12 0.01 0.02 0.02 0.01 0.01 0.01 0.00 0.02 0.11 0.19 0.59 1.00 0.39 0.23 0.19 0.06 0.04 0.01 0.02 0.00 0.04 0.03 0.02 0.03
Ox(ppm)_lag17 0.01 0.03 0.07 0.21 0.14 0.58 1.00 0.50 0.20 0.06 0.02 0.00 0.01 0.02 0.01 0.03 0.01 0.01 0.03 0.04 0.02 0.00 0.02 0.02
U 1.00 0.84 0.80 0.81 0.72 0.64 0.49 0.49 0.43 0.48 0.42 0.41 0.42 0.39 0.43 0.36 0.21 0.16 0.16 0.13 0.10 0.12 0.06 0.00
Ox(ppm)_lag2 0.28 0.20 0.45 0.29 0.24 0.14 0.09 0.11 0.20 0.20 0.09 0.07 0.07 0.09 0.05 0.05 0.01 0.00 0.09 0.21 0.39 1.00 0.93 0.38
Ox(ppm)_lag13 0.01 0.00 0.01 0.03 0.02 0.02 0.04 0.05 0.19 0.62 1.00 0.49 0.24 0.21 0.11 0.03 0.00 0.04 0.03 0.04 0.02 0.03 0.04 0.03
Ox(ppm)_t+01 Ox(ppm)_t+02 Ox(ppm)_t+03 Ox(ppm)_t+04 Ox(ppm)_t+05 Ox(ppm)_t+06 Ox(ppm)_t+07 Ox(ppm)_t+08 Ox(ppm)_t+09 Ox(ppm)_t+10 Ox(ppm)_t+11 Ox(ppm)_t+12 Ox(ppm)_t+13 Ox(ppm)_t+14 Ox(ppm)_t+15 Ox(ppm)_t+16 Ox(ppm)_t+17 Ox(ppm)_t+18 Ox(ppm)_t+19 Ox(ppm)_t+20 Ox(ppm)_t+21 Ox(ppm)_t+22 Ox(ppm)_t+23 Ox(ppm)_t+24
Target
Normalized Importance (per step)
1.0
0.8
0.6
0.4
0.2
0.0